

***United States Court of Appeals
for the
District of Columbia Circuit***



**TRANSCRIPT OF
RECORD**

**BRIEF AND APPENDIX
FOR APPELLANT**

COURT OF APPEALS
DISTRICT OF COLUMBIA

FILED DEC 18

Joseph W. Starnes

IN THE
United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA.

No. 8359

MAGNAFLUX CORPORATION, a Corporation,
Appellant,

v.

CONWAY P. COE, Commissioner of Patents,
Appellee.

998

**Appeal from the Judgment of the United States District
Court for the District of Columbia.**

CHARLES W. HILLS, JR.,
DONALD J. SIMPSON,
53 W. Jackson Blvd.,
Chicago, Illinois.

THOMAS J. MACKAVANAGH,
633 Munsey Building,
Washington, D. C.,
Attorneys for Appellant.

INDEX AND TABLE OF CASES.

INDEX.

	Page
Jurisdictional Statement	1
Statement of the Case	2
Statutes Involved	8
Statement of Points	8
Summary of Argument	9
Argument	10
The Doane Invention	10
The Prior Art Fails to Teach the Doane Invention.	12
The Law Justifies a Holding of Patentability.....	16
Conclusions	20

TABLE OF CASES.

Burgess Battery Co. v. Coe, 34 Fed. Supp. 377; 46 U. S. P. Q. 451	16
Diamond Rubber Co. v. Consolidated Tire Co., 220 U. S. 428, 435	20
Electrons, Inc. v. Coe (App. D. C., 1938), 69 App. D. C. 181; 99 F. (2d) 414; 38 U. S. P. Q. 370.....	17, 18, 21
Expanded Metal Company v. Bradford, 214 U. S. 366..	19
Hoeltke v. Kemp Mfg. Co. (C. C. A. 4), 80 F. (2d) 912, 26 U. S. P. Q. 114	19
In re Huff, 1919 C. D. 152	20
Star Brass Works v. General Electric Co. (C. C. A. 6), 111 Fed. 398, 400	19

IN THE
United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA

No. 8359

MAGNAFLUX CORPORATION, a Corporation,
Appellant,

v.

CONWAY P. COE, Commissioner of Patents,
Appellee.

**Appeal from the Judgment of the United States District
Court for the District of Columbia.**

BRIEF FOR APPELLANT.

JURISDICTIONAL STATEMENT.

This is a suit in equity against the Commissioner of Patents which arose because of the refusal of the United States Patent Office to grant a patent upon an application which is owned by plaintiff-appellant.

Jurisdiction in the District Court as well as in this Court is based on the provisions of the Revised Statutes, Title LX, Section 4915 (U. S. C., Title 35, Sec. 63; 27 Stat. 436). The complaint and answer in the court below (Appellant's App. 3 and 7) set forth and admit the jurisdiction.

The present suit was filed in the United States District Court for the District of Columbia within six months after the Board of Appeals of the United States Patent Office affirmed the earlier decision of the Primary Examiner denying a patent to the appellant here. No appeal was taken from the decision of the Board of Appeals to the United States Court of Customs and Patent Appeals.

STATEMENT OF THE CASE.

On June 21, 1935, an application for patent entitled "Improvement in Process of Magnetizing" was filed in the United States Patent Office by Foster B. Doane, and was assigned Serial Number 27,756. (Plaintiff's Exh. 2.)

At a later date, and while this application Serial No. 27,756 was still pending, an application for patent entitled "Magnetic Testing Method and Means" was filed in the United States Patent Office on April 24, 1939, by Foster B. Doane, and was assigned Serial No. 269,644. (Plaintiff's Exh. 1.) This second application was a continuation-in-part of the earlier filed application Serial No. 27,756, it having been based in part on the original disclosure of the earlier application.

By an assignment in writing duly executed by the applicant, Foster B. Doane, under date of April 21, 1939, and duly recorded in the United States Patent Office under date of April 24, 1939, plaintiff-appellant herein acquired title to the invention and application Serial No. 269,644. The entire right, title, and interest in and to said application for patent Serial No. 269,644 is now vested in plaintiff-appellant. (This is admitted in the pleadings.)

The Doane application Serial No. 269,644 described a novel method and means for non-destructive testing of mag-

netizable metal objects to determine the presence of surface or subsurface defects.

A number of years ago it was determined that if a steel part were magnetized and paramagnetic particles were distributed over the surface of the part, these particles would be more densely grouped over any minute crack or sub-surface defect, thus providing an indication of the presence of any defect. This type of test provided a simple and easy way to check each and every part to determine whether or not it was defective.

The accuracy and reliability of such tests depended on two important facts. First, it was absolutely necessary that each test piece be magnetized, and second, it was necessary that the magnetization of the piece be uniform for all similar pieces being tested. These two essential prerequisites of the test were necessary due to the fact that it is a negative indication which signifies that the part being tested is free of defects. If the operator were not sure that the part had been properly magnetized, however, a negative indication (i.e., the lack of any specific grouping or congregation of particles anywhere on the surface of the piece), would leave him uncertain as to whether the part being tested was free of flaws or whether the part had just not been magnetized sufficiently to cause a congregation of paramagnetic particles even if a flaw were present.

Prior to the present invention, the required dependability which was so essential to tests of this character was obtained only through the expedient of direct current energized magnetizing circuits. Although alternating current magnetizing circuits would have been more convenient and the necessary apparatus would have been cheaper to manufacture, no alternating current energizing circuits were employed in flaw-detecting apparatus of the above character, *for it was believed impossible to foretell in advance* whether magnetization would always result from the use of an alternating current energizing circuit. The element of dependability was lacking.

The applicant Doane, however, discovered a new combination of old elements which surmounted the difficulties previously believed to exist, and provided an alternating current energizing circuit having the desired requisite of dependability.

Doane realized that the difficulty in using alternating current and the reason it was unsatisfactory prior to his invention was the uncertainty of the time of interruption of the current and the fact that in a large number of instances the last few cycles immediately prior to the point of interruption were highly damped. The first circumstance made it uncertain whether any magnetization would result in the piece, and the second condition made it additionally highly uncertain whether the magnetization, if any, would be sufficient to make the device usable in any type of magnetic testing apparatus. Doane discovered, however, that if a current-interrupting means of a certain definite type were provided in combination with the magnetizing circuit, magnetization would always be obtained, and furthermore would be always of sufficient intensity to provide a sure test for flaws.

The three contested claims of the Doane application Serial No. 269,644 involved in the present suit, namely, claims 17, 18, and 19, are quoted below:

"17. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until

the current wave reaches a value of substantially zero, and to then interrupt said circuit.

"18. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero and to then interrupt said circuit, said switch means comprising mercury confined within an envelope.

"19. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero, and to then interrupt said circuit, said switch means comprising means to form an ionized vapor and electro-magnetic means to de-ionize said vapor."

Claim 17 is generic to all of the illustrated embodiments of the invention shown in the drawing of the Doane appli-

cation. Claim 18 is more specific than claim 17, the generic claim, in that it limits the circuit-interrupting means to a mercury switch. The third claim, claim 19, is also similar to the generic claim, with the exception that the interrupting means is limited to a switch of the de-ion type.

An inspection of claim 17 will clearly show that the only protection which is being sought is protection on the particular and peculiar circuit combination which has heretofore been discussed. This claim carefully and in detail brings out the essential features and characteristics of the circuit combination which enable the circuit to carry out the result desired.

The claims were not rejected by the Patent Office on the ground that they were met by any one of the references which have been set up in the answer in this suit, but rather on the ground that the step forward in the art which was taken by Doane was not of such a character as to amount to inventive skill, and hence was not a patentable step forward in the art.

The Patent Office refused to grant a patent on the Doane application Serial No. 269,644 on the ground that it deemed the claims unpatentable in view of the following prior patents:

Wilson	533,938	Feb. 12, 1895
Hewitt	799,052	Sept. 12, 1905
Kraus	1,046,086	Dec. 3, 1912
Slepian	1,932,090	Oct. 24, 1933
De Forest	2,110,759	Mar. 8, 1938
Van Meyl (French)	593,863	June 6, 1925
Hauser (British)	379,337	Aug. 26, 1932

The above references, with the exception of the De Forest patent 2,110,759, were used against all of the claims. The De Forest patent was relied on by the Patent Office only in connection with claim 19, since it was not early enough to be used against claims 17 and 18, which were supported by the disclosure of the earlier Doane application Serial No. 27,756.

An appeal was taken to the Board of Appeals of the Patent Office from the final rejection of the Primary Examiner. The Board of Appeals affirmed the decision of the Primary Examiner. A request for reconsideration of its decision was filed, and the Board of Appeals adhered to its decision, stating in part:

“As we understand the matter, there is no particular objection to opening the circuit at the crest of the wave if this can be expeditiously accomplished. Appellant's expedient of opening the circuit at the zero point is no way superior, in so far as results are concerned, but his is an expedient which can be utilized without any substantial sacrifice of efficiency. It is because of this that appellant is enabled to use a circuit closer which opens the circuit at the zero point of the current wave rather than its crest. If appellant were the first to recognize that a magnetizing circuit could be opened at the zero point without sacrifice of magnetizing efficiency, there might be some element of patentability in the subject matter appealed. It was for the purpose of showing that appellant was not the first to recognize this that we called specific attention to the Hauser patent.” (Pl. Ex. 1 and Dft. Ex. 1, Item K)

Among other things, appellant here contends that the premise on which the Board of Appeals based its decision, as indicated in the above quotation, is erroneous, and that the decision therefore should have been the reverse of what it actually was.

The claims were not rejected by the Patent Office on the ground that they were met by any one of the references set forth above, but rather on the ground that the step forward in the art which was taken by Doane was not of such a character as to amount to inventive skill, and hence was not a patentable step forward in the art.

Within the prescribed time after the decision of the Patent Office Board of Appeals, appellant filed an action against the Commissioner of Patents under R. S. 4915 in the court below to compel the issuance of a patent with the three

claims quoted above. After a hearing, judgment for the defendant was rendered by the court below. Thereupon, appellant lodged the present appeal from that decision.

STATUTES INVOLVED.

The principal statutes involved in the present suit and appeal are the patent statutes of the United States.

It is believed that the only statute that is involved in the issue of the present case, directly or indirectly, is R. S. 4886, as amended by the Act of May 23, 1930, 46 Stat. L. 336 (U. S. C., Title 35, Section 31). This section reads as follows:

“Any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof, or who has invented or discovered and asexually reproduced any distinct and new variety of plant, other than a tuber-propagated plant, not known or used by others in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof or more than two years prior to his application, and not in public use or on sale in this country for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law, and other due proceeding had, obtain a patent therefor.”

STATEMENT OF POINTS.

1. The appellant in this case respectfully contends that the District Court erred in holding that it was not invention to substitute a mercury switch such as that shown in the patents to Wilson, Hewitt, or Kraus for the polarized relay in the Hauser circuit, notwithstanding the fact that it was desirable to use altering current in magnetic testing equipment, and notwithstanding the fact that alternating current equipment was not used in magnetic testing apparatus until after the Doane teaching.

2. The appellant further respectfully contends that the District Court erred in holding that it was not invention to substitute the de-ion circuit breaker of Slepian for the polarized relay of Hauser, notwithstanding the fact that there is no suggestion in the Slepian patent that a de-ion circuit breaker may be used in an alternating current magnetizing circuit, and notwithstanding the fact that while it was desirable to use alternating current in a magnetizing circuit, no such use is to be found until after the Doane teaching.

3. The appellant further respectfully contends that the District Court erred in holding that claims 17, 18, and 19 of the Doane application define no invention over the French patent to Van Meyl or the British patent to Hauser in view of the prior art, notwithstanding the absence of any suggestion that patents such as Hewitt, Kraus, or Slepian may be combined with Van Meyl or Hauser, and notwithstanding the fact that the Van Meyl and Hauser references teach the contrary.

4. It is further respectfully contended that the District Court erred in holding that plaintiff-appellant is not entitled to a patent based on the Doane application Serial No. 269,644 containing claims 17, 18, and 19, or any of them.

SUMMARY OF ARGUMENT.

The claims which plaintiff is seeking in the Doane application Serial No. 269,644 define and set forth a new combination of old elements which is neither shown nor suggested by the teachings of the prior art.

The uncontradicted evidence in this case shows the peculiar nature of the problem involved and the absolute necessity of obtaining a solution which will provide one hundred per cent (100%) reliability and substantial uniformity.

The defendant in this case relies heavily, if not entirely, on an alleged suggestion found in an introductory portion of the British patent No. 379,337 to Hauser. Plaintiff contends that the only teaching in the Hauser patent which may properly be considered is one which would be apparent to a

person skilled in the art. When the British patent is viewed from the four corners of its description, it is apparent that the supposed teaching urged by defendant is not to be found; indeed, a directly contrary teaching is found. Plaintiff's expert, John E. Clarke, who was qualified as a person skilled in the art, testified that he found no suggestion of the Doane combination in the British patent. This was corroborated by the witness Grant W. Coon, who was also qualified as a person skilled in this art. No testimony or other evidence was offered by defendant as to what the disclosure of the Hauser patent might mean to a person skilled in the art.

The other prior art references likewise fail to show or suggest the novel combination of Doane.

Since the prior art relied upon by defendant fails to teach the Doane invention, and since a very real problem existed which Doane for the first time solved, it is respectfully submitted that plaintiff is entitled to the relief prayed for in this suit.

ARGUMENT.

The Doane Invention.

The Doane invention relates to the use of alternating current as an energizing medium in the magnetizing circuit of flaw-detecting apparatus. The problem involved in this field was a peculiar one, due to the fact that a predetermined minimum magnetization must be obtained in one hundred per cent (100%) of the articles being tested. Prior to Doane it was believed impossible to use alternating current in such apparatus, because of the uncertainty and lack of uniformity in the result. Doane discovered, however, that if the alternating current circuit is so designed and arranged as to enable interruption of the circuit at a zero point of the alternating current cycle, maximum magnetization would always result. The industry recognized the reliability of the Doane circuit combination, and a very substantial and nation-wide business followed in apparatus embodying the Doane invention.

The core of appellant's contentions is that neither the Patent Office nor the court below really grasped the essence of the invention which Doane has made, nor appreciated precisely what the disclosures of the prior patents would mean to a person skilled in the art.

Because the prior art, in scattered patents, shows the two specific interrupting means of Doane, and also in isolated patents shows magnetizing circuits for other purposes, it has been held that there is no invention disclosed by the Doane application, apparently predicated on the ground that the step forward taken by Doane is too short an advance in the art to amount to invention. It is significant that it is tacitly admitted by defendant that Doane did make an advance of some sort.

Two points are entirely overlooked or ignored in such a view of the Doane invention, both closely related to each other:

1. The fact that the prior disclosures are looked at with a fresh eye, quickened by the disclosure of Doane;
2. The fact that the prior disclosures, even when placed side by side or built up one upon another, fail to form a hypothetical combination equivalent to what Doane has provided.

In other words, the things which are now advanced as reasons for denying a patent on the Doane application did not lead others in the field to make the invention which Doane made. Looking back over the trial Doane has broken, it is relatively easy to pick out his footprints and point out that anyone else might have followed a similar path from the well-marked road of the prior art and arrived at the same goal. This, however, ignores the fact that no one else did accomplish what Doane has accomplished, although the need was ever present.

The Prior Art Fails to Teach the Doane Invention.

The Wilson, Hewitt, Kraus, and Slepian patents were cited by the Patent Office as being illustrative of prior art disclosures showing mercury switches or de-ion circuit breakers used for other purposes, and further to show that it was old to open a circuit at the zero point of an alternating current wave, but not for the purpose of obtaining maximum magnetization.

Kraus (Appellant's App. 121-124) discloses a mercury switch which interrupts an alternating current circuit to eliminate dangerous and destructive arcs (page 1, lines 12 and 13 of the patent)—not for the purpose of obtaining a maximum magnetization. There is no suggestion in the Kraus patent that the Kraus switch may or should be employed in an alternating current magnetizing circuit.

Wilson (Appellant's App. 113-116) opens a semaphore signal control circuit with a mercury switch, but there is no mention of whether the circuit is A. C. or D. C., and there is no mention or suggestion that his switch may or should be used in a magnetizing circuit.

Hewitt (Appellant's App. 117-120) opens an alternating current power circuit with a mercury switch, but there is no mention or suggestion that his switch should be employed in a magnetizing circuit.

Slepian (Appellant's App. 125-129) merely discloses a de-ion circuit breaker per se, but there is no suggestion of its use in a magnetizing circuit.

The French patent to Van Meyl (Appellant's App. 135, 137-140) describes an alternating current magnetizing circuit with a fuse as an interrupter. When a fuse opens an electrical circuit depends, of course, solely upon the heat necessary to melt the fuse element.

The British patent to Hauser (Appellant's App. 141-143) discloses an alternating current magnetizing circuit having a polarized relay therein for effecting interruption of the alternating current at the crest of the current wave. Hauser on page 1, lines 23 to 27, states:

“With a hand operated switch it is obviously impossible to effect with any certainty the interruption at the right moment of the alternating current traversing the magnetizing coils.”

The thing that Hauser states is *obviously impossible* is the very thing that the combination of Doane has made possible. A mercury switch is a hand-operated switch. When Hauser tells us that the combination is obviously impossible, and tells us that the switch opens the circuit of the magnetizing coil at the crest of the alternating current wave, *we cannot possibly say that he anticipates a combination that rejects his own teaching completely.*

Counsel for defendant during the trial in the District Court attempted to stress certain statements made in the introductory paragraphs of the Hauser patent. It is, of course, improper to isolate phrases from a complete disclosure and attempt to draw conclusions therefrom contrary to the clear teaching and implications of the complete disclosure when read as a whole.

The testimony of plaintiff's two expert witnesses at the trial of this case, namely, John E. Clarke and Grant W. Coon, remains uncontradicted except by the interpretation of defendant's counsel of this reference cited by the Patent Office. The witness Clarke, who was qualified as an expert in this field, testified that he did not find any suggestion in the Hauser patent that the current wave will always be interrupted at the zero point of the current cycle (Appellant's App. 48). The witness Clarke further testified that the statement in one of the introductory paragraphs of the Hauser patent which appears on page 1 thereof beginning with line 28 is ambiguous and not clear (Appellant's App. 48). The witness Coon, who was qualified as an expert in this particular field, also testified that Hauser does not suggest opening the current wave at the zero point of the current cycle. (Appellant's App. 93.) He further points out that Hauser claims:

“ * * * it will open at the crest of the cycle.” (Appellant's App. 93.)

On page 1 of the Hauser patent, in the paragraph beginning with line 12, the first sentence merely states that the invention relates to a magnetizing apparatus which uses alternating current.

The second sentence, beginning in line 14, points out that with magnetizing devices which employ alternating current it has hitherto proved a matter of difficulty, first, to obtain the maximum magnetizing effect, and second, to obtain the desired polarity. There is nothing in this statement to warrant the conclusion which counsel for the defendant has urged in the trial of this case in the District Court that it has been difficult to obtain the maximum magnetizing effect and at the same time obtain desired polarity. The sentence referred to unequivocally states that difficulty has been met with two distinct and separate problems which arose in connection with alternating current magnetizing circuits.

The third sentence of this same paragraph states that with a hand operated switch it is obviously impossible to obtain any degree of certainty in magnetizing result.

The fourth sentence is the sentence which counsel for defendant has attempted to lift from the body of the British patent and urge as an anticipation of the Doane invention. Indeed, counsel for defendant has gone even further, for during the trial in the court below he pointed out that in order to read this sentence properly, the two clauses in the middle should be completely disregarded. At best, the sentence referred to is a very ambiguous statement. If the sentence is interpreted in its most favorable light from the standpoint of the defendant-appellee's position and paraphrased, it would merely state:

Even interruption at the zero point of the current wave merely ensures interruption at a moment when the field of the secondary winding is at a crest, but does not give the desired polarity in the object to be magnetized.

This, of course, does not anticipate applicant Doane's invention, nor even suggest it.

When the second paragraph of the Hauser patent is viewed from the four corners of the disclosure, it is clear that Hauser was concerned with one and only one problem, namely, he wanted to provide some automatic opening mechanism which would give him the desired polarity he wanted, if the object were magnetized. That is to say, he is not concerned primarily with whether the object is magnetized at the first attempt, but is desirous of obtaining proper polarity of magnetization when the object is magnetized, whether that be on the first or the hundredth attempt. To this end, he provides a polarized relay which is actuated when the current wave first reaches a crest of one polarity or sign.

The evidence in this case shows clearly the unusual nature of the problem involved and the reason why the Doane solution is important. A large number of tests were made by Grant Coon under the direction and supervision of John E. Clarke to illustrate the uncertainty of results when an alternating current magnetizing circuit is opened by a fuse or by a knife switch. The opening of such a circuit by a fuse is what is shown in the Van Meyl French patent 593,863. The opening of the circuit by a knife switch is the equivalent of opening the circuit with an interrupter of the type shown in the British patent to Hauser, the only difference being that Hauser provides an automatic means for opening the contacts to obtain desired polarity. (Appellant's App. 48.)

The evidence shows that when an alternating circuit is opened with a mercury switch, satisfactory magnetization of the object always results. (Appellant's App. 61 and Plaintiff's Exh. 16 and 16A.)

The evidence further shows that opening an alternating current magnetizing circuit with a de-ion circuit breaker always produces the desired degree of magnetization in the object. (Appellant's App. 2 and Plaintiff's Exh. 17 and 17A.)

The evidence shows that a contrary result is obtained when an alternating current magnetizing circuit is opened by a fuse, and particularly shows that the piece may or may not be magnetized. (Appellant's App. 63 and Plaintiff's Exh. 18 and 18A.)

The evidence also shows that opening an alternating current magnetizing circuit by separating metal contacts, such as a knife switch, produces unsatisfactory results from which it cannot be determined in advance whether the object will be magnetized. (Appellant's App. 64 and Plaintiff's Exh. 19 and 19A.)

The Law Justifies a Holding of Patentability.

While the elements of the combination as claimed in the Doane application may individually have been known prior to the filing of the Doane application, *there is no realization in the prior art that the vital thing needed to always obtain maximum magnetization of a test piece by use of an alternating current magnetizing circuit is an interrupting means which will interrupt the current at substantially the zero point of the current wave.* Doane realized the deficiencies of the prior art technique. *He thereafter solved the defects by combining certain elements in such a way that uniform, dependable, and consistent results could be obtained.* This contribution to the development of this particular art was a very real and important contribution. Immediately following the time when Doane made this invention, the invention was accepted by the industry and met with widespread commercial success. (Appellant's App. 77-78.)

It is a well-known and accepted principle of patent law that even though the elements of a claim may be individually old, if the combination is novel and useful, it is a patentable combination.

In a recent case, *Burgess Battery Co. v. Coe*, 34 Fed. Supp. 377, 46 U. S. P. Q. 451, an application for patent was under

consideration in which the applicant was claiming a combination, all of the elements of which were old and well known in the art. The subject matter of the application related to closures for dry cell batteries, containing a socket connection for attaching a pronged plug connection. Mr. Justice Morris, in delivering the opinion of the court, stated:

“The evidence introduced at the hearing in this cause shows the large number of hearing-aid devices so constructed that almost all of them require a battery specially made for such device. The different number of prongs, or the different spacings of prongs, or the different size of the prongs, made it necessary for a battery dealer to carry a very large variety of batteries if the user of any one of a large number of hearing-aid devices was to be seasonably served. With the advent of the device produced by the plaintiff, a battery could be provided to a user of any one of substantially all of the hearing-aid devices on the market. While the commercial success of the plaintiff's construction is not in itself conclusive on the question of whether or not such construction involved invention, it is strong evidence that the art as it was theretofore known did not show an obvious solution to a very great need. *If making use of known constructions in such combination and arrangement as produce new and useful results is not to be considered as invention, then it is not to be thought that there will be such continued effort and experimentation as was sought to be encouraged by the provisions of the Constitution and patent laws of our country. Reaching the conclusion, as I do, that the claims here involved disclose a patentable construction, the relief prayed for in the complaint will be granted, and the Commissioner of Patents authorized to issue letters patent.*” (Italics ours.)

In a recent case which came before this Court, *Electrons, Inc. v. Coe*, 69 App. D. C. 181; 99 F. (2d) 414; 38 U. S. P. Q. 370, the question of the patentability of certain combination claims, all of the elements of which were old in the art, was before the Court for consideration. As in the previously cited case, the question arose in a suit under the provisions

of R.S. 4915, as amended. The applicant in this case was seeking patent protection on a device for producing ultra-violet rays. The invention was said to lie in the discovery that mercury may be vaporized by electronic bombardment caused by a heavy electric discharge made possible by the use of the Wehnelt cathode, which was old in the art, through an inert gas, which was old in the art. The defendant contended that

“* * * the virtues of the Wehnelt cathode have long been known and * * * the principles employed by the appellants are disclosed by the prior art and especially by the patent to Kruh, No. 1,032,914, and the patents to George, No. 1,671,109 and No. 1,361,710.”

and also that

“* * * stripped of the limitations stated in functional terms, the claims in the Meyer application are literally anticipated by the substitution of the rare gas of George in the Kruh tube.”

Mr. Justice Stephens, in delivering the opinion of this Court, stated (page 379):

“We reach the conclusion that despite Kruh and George the Meyer lamp is an inventive combination. Without dispute there was need in the art of an ultra violet ray producing device free from the disadvantages which are described at the outset of this opinion; and clearly enough the Meyer device accomplishes that result. It produces ultra violet rays in a much more efficient way than before. While improvement in method through the Meyer structure may seem obvious now, we are impressed with the arguments of the appellants that it was not obvious from the prior art.”

The circumstances and facts involved in the *Electrons, Inc.* case are very similar to the present case.

In each case the elements of the combination were old. In each case the results, after they were obtained, appeared simple. In each case the results obtained provided a much

more efficient way of attaining the desired ends than had previously been provided.

In *Star Brass Works v. General Electric Co.*, (C. C. A. 6) 111 Fed. 398, 400, the rule is thus stated by Judge (later Mr. Justice) Day:

“It is too well settled to need extended citation of authorities to support the proposition that a new combination of elements old in themselves, producing a new and useful result, entitles the inventor to the protection of a patent. *Loom Co. v. Higgins*, 105 U. S. 580, 591, 26 L. Ed. 1177. It may be true that Anderson has only taken the familiar contact spring or brush, and placed it in a protected position, but this change seems to have made the difference between a defective mechanism and a practical method of attaining the desired end.”

This case is also very similar to the circumstances of the present suit, for here the change in arrangement of elements made the difference between a defective and unsatisfactory magnetizing circuit combination and a practical and usable magnetizing circuit for attaining the desired result.

Again in *Hoeltke v. Kemp Mfg. Co.*, (C. C. A. 4), 80 F. (2d) 912, 26 U. S. P. Q. 114 (on rehearing 80 F. (2d) 912, 28 U. S. P. Q. 176), it was stated:

“While each of the devices which complainant uses is to be found in one or more of the patents cited, none of these patents covers any such combination as * * * complainant has evolved.”

The court in this case held the combination patentable.

Merely because an invention appears simple after it has been made is no indication that the invention is not a patentable one. This Court's attention is respectfully called to the statement by the Supreme Court of the United States in *Expanded Metal Company v. Bradford*, 214 U. S. 366:

“It is often difficult to determine whether a given improvement is a mere mechanical advance, or the result of the exercise of the creative faculty amounting to a meritorious invention. *The fact that the invention*

seems simple after it is made does not determine the question; if this were the rule, many of the most beneficial patents would be stricken down. It may be safely said that if those skilled in the mechanical arts are working in a given field and have failed after repeated efforts to discover a certain new and useful improvement, that he who first makes the discovery has done more than make the obvious improvement which would suggest itself to a mechanic skilled in the art, and is entitled to protection as an inventor." (Italics ours.)

In considering any question of patentability of a new invention over the prior art, it must of course be remembered that

*"Knowledge after the event is easy, and problems once solved present no difficulties, indeed, may be represented as never having had any, and expert witnesses may be brought forward to show that the new thing which seemed to have eluded the search of the world was already at hand and easy to be seen by merely skillful attention * * * The law has other tests of invention than subtle conjectures of what might have been seen and yet was not."* *Diamond Rubber Co. v. Consolidated Tire Co.*, 220 U. S. 428, 435. (Italics ours.)

and that

"Many things appear easy after they have been explained, and doubtless many a man has wondered why he failed to think of some apparently simple device or improvement that yielded a fortune to the one who did and revolutionized an industry. The simple fact is that the average person sees things as they are, and he who has originality of vision enabling him to visualize defects and the means of overcoming them should receive adequate reward." *In re Huff*, 1919 C. D. 152. (Italics ours.)

CONCLUSIONS.

Although the individual elements of the Doane combination are found isolated in other environments, when grouped together as defined by Doane, a new and patentable combination results in the same manner and for the same rea-

sons stated by Mr. Justice Stephens in the *Electrons, Inc. v. Coe* case.

The problem was present and remained unsolved until the art was provided a solution by Doane. Such an advance in the art, while it might appear simple now that the step has been taken, was nevertheless *an important advance* which was promptly accepted and adopted by the industry. The prior rulings and decisions adverse to appellant's interest are believed to have been taken and predicated entirely on a misunderstanding and misinterpretation of what the prior art disclosures would and did mean to persons skilled in this art. The evidence in this case clearly shows that the premise upon which the prior decisions were made was in fact a false premise.

When due consideration is given to the evidence in this case, only one conclusion can be reached, and that is that the prior art does not teach persons skilled in this art the novel combination defined by claims 17, 18, and 19 of the Doane application Serial No. 269,644.

Accordingly, it is prayed that the decision of the District Court be reversed, and that defendant-appellee be authorized to issue a patent on the Doane invention containing these claims.

CHARLES W. HILLS, JR.,
DONALD J. SIMPSON,
53 W. Jackson Blvd.,
Chicago, Illinois.

THOMAS J. MACKAVANAGH,
633 Munsey Building,
Washington, D. C.,
Attorneys for Appellant.

APPENDIX

INDEX TO APPENDIX TO BRIEF FOR APPELLANT.

	Page
Complaint to compel issuance of patent	2
Answer to the Complaint	7
Appearance	9
Findings of Fact	9
Conclusions of Law	11
Judgment	12
Notice of Appeal	12
Order	13
Memorandum	13
Opening statement of plaintiff	14
Testimony of John E. Clarke	23
Direct examination	23
Cross examination	80
Redirect examination	82
Testimony of Grant W. Coon	86
Direct examination	86
Argument of counsel for plaintiff	94
Argument of counsel for defendant	101
Reporter's Certificate	107
Order	107
Designation of Contents of Record on Appeal	108
Declaration as to Designation	111
Patent 533,938 to Wilson	113
Patent 799,052 to Hewitt	117
Patent 1,046,086 to Kraus	122
Patent 1,932,090 to Slepian	126
Patent 2,110,759 to DeForest	131
Drawing of French patent 593,863 to Van Meyl	135
Translation of French patent 593,863	137
British patent 379,337 to Hauser	141

IN THE
United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA.

No. 8359.

MAGNAFLUX CORPORATION, a Corporation,
Appellant,

v.

CONWAY P. COE, Commissioner of Patents,
Appellee.

Appeal from the District Court of the United States for
the District of Columbia.

APPENDIX TO BRIEF FOR APPELLANT.

I.

PLEADINGS, DOCKET ENTRIES AND OTHER
PAPERS DESIGNATED BY APPELLANT.

1 Endorsed: Filed Aug 11 1941 Charles E. Stewart, Clerk.

In the District Court of the United States for the
District of Columbia

Civil Action No. 12438

MAGNAFLUX CORPORATION, a Corporation, 5808 Northwest
Highway Chicago, Illinois, *Plaintiff*

vs.

CONWAY P. COE, Commissioner of Patents, *Defendant*

Plaintiff's Attorney:

Thomas J. MacKavanagh
633 Munsey Building
Washington, D. C.

Complaint to Compel Issuance of Patent

To the Honorable Judges of the District Court of
the United States for the District of Columbia:

The plaintiff states as follows:

I

The plaintiff, Magnaflux Corporation, is a corporation organized under and existing by virtue of the laws of the State of Delaware, having a regular and established place of business in the City of Chicago, State of Illinois.

II

The defendant, Conway P. Coe, is the Commissioner of Patents of the United States, a legal resident of the District of Columbia, and is sued as Commissioner of Patents of the United States.

III

This action arises under Section 4915 of the Revised Statutes of the United States.

IV

Prior to April 24, 1939, Foster B. Doane, plaintiff's assignor, was, within the meaning of the laws of the United States then in force, the first, original, and sole inventor of certain new and useful improvements in Magnetic Testing Method and Means.

V

On April 24, 1939, an application for patent of said Foster B. Doane for said invention, entitled "Magnetic Testing Method and Means", disclosing and claiming said improvements as his invention, was filed in the United States Patent Office, which application was given Serial No. 269,644.

VI

The said application was filed in accordance with the laws of the United States and the rules of the Patent Office.

VII

By an assignment in writing, duly executed by said applicant Foster B. Doane under date of April 21, 1939, and duly recorded in the United States Patent Office under date of April 24, 1939, in Liber B-179, page 209, of the Transfers of Patents, plaintiff herein acquired title to said invention and application. The entire right, title, and interest in and to said invention and application Serial No. 269,644 is now vested in plaintiff.

VIII

The said application has been duly prosecuted in accordance with the laws of the United States and the rules of the Patent Office.

IX

Said application Serial No. 269,644 has been passed upon by the Primary Examiner, who refused to allow the following claims:

"17. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero, and to then interrupt said circuit.

"18. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero and to then interrupt said circuit, said switch means comprising mercury confined within an envelope.

"19. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series

circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero, and to then interrupt said circuit, said switch means comprising means to form an ionized vapor and electro-magnetic means to de-ionize said vapor."

4 which he finally rejected in accordance with the rules of the Patent Office.

X

The aforesaid applicant appealed from the decision of the Primary Examiner to the Board of Appeals of the Patent Office, which in its decision dated February 12, 1941, affirmed the final rejection of said claims 17, 18, and 19 by the Primary Examiner, and in a further decision dated March 19, 1941, upon a petition for reconsideration of its decision of February 12, 1941, again affirmed said final rejection.

XI

The defendant contends that the disclosures of the following reference patents:

Van Meyl (French)	593,863	June 6, 1925
Hauser (British)	379,337	Aug. 26, 1932
Wilson	533,938	Feb. 12, 1895
Hewitt	799,052	Sept. 12, 1905
Kraus	1,046,086	Dec. 3, 1912
Slepian	1,932,090	Oct. 24, 1933
deForest	2,110,759	Mar. 8, 1938

anticipate the invention defined by the aforesaid claims 17, 18, and 19, and that there is no invention involved in the subject matter of said claims.

XII

Plaintiff disagrees with these contentions of defendant, and contends that none of the aforesaid references, taken either singly or in combination, discloses the invention defined by said claims, and that said claims do properly define a novel and patentable invention over such disclosures; and that said claims set forth in Paragraph IX are allowable and patentable, and plaintiff is therefore entitled to have issued to it a patent containing said claims.

5

XIII

The said invention is new and useful, and was not known or used by others in this country before the invention thereof by said applicant, and not patented or described in any printed publication in this or any foreign country before said applicant's invention thereof or more than two years prior to his application for patent therefor, and not in public use or on sale in this country for more than two years prior to said application, and not patented in any foreign country by him or his legal representatives on an application filed more than twelve months prior to said application for United States letters patent, and not abandoned.

XIV

Defendant, wrongfully, has refused and still refuses to grant letters patent upon the aforesaid application Serial No. 269,644, and plaintiff is lawfully entitled to such letters patent.

Wherefore the plaintiff prays that this Honorable Court adjudge that plaintiff is entitled to receive a patent with the claims set forth in Paragraph IX hereinabove, or such other and modified claims as the Court may deem patentable.

ble, and that this Court authorize the defendant to issue to plaintiff a patent with such claims.

THOMAS J. MacKAVANAGH
633 Munsey Building
Washington, D. C.

The Firm of CHARLES W. HILLS
1414 Monadnock Building
Chicago, Illinois

CARLTON HILL
1414 Monadnock Building
Chicago, Illinois

Of Counsel

Washington, D. C.
August 11, 1941

* * * * *

6 *Answer to the Complaint.*

To the Honorable the Justices of the District Court of the United States for the District of Columbia.

I. Defendant admits the allegations of paragraph I.

II. He admits the allegation of his official position and that he is sued in his official capacity. He denies that he is a legal resident of the District of Columbia, his legal residence being in the State of Maryland. He admits that his official residence is in the District of Columbia.

III. He admits the allegations of paragraph III.

IV. He admits that on April 24, 1939, Foster B. Doane, claiming to be the first, original and sole inventor of certain alleged new and useful improvements in "Magnetic Testing Method and Means", filed in the Patent Office an application for patent thereon. He denies, for reasons hereinafter given, that the subject-matter claimed in said application is patentable.

V. He admits that said application was filed on April 24, 1939, that said application disclosed and claimed said

alleged means, and that said application was given Serial No. 269,644.

VI, VII, VIII, IX, X, XI. He admits the allegations of paragraphs VI to XI, inclusive.

XII. He denies the allegations of paragraph XII.

XIII. He admits that in said application Foster B. Doane made averments corresponding to the allegations of paragraph XIII but denies, for reasons hereinafter given, that plaintiff is lawfully entitled to receive a patent on said application.

XIV. He admits that he has refused and still refuses to issue to plaintiff a patent containing any one of claims 17, 18 and 19 of said application. He denies that plaintiff is lawfully entitled thereto since it is deemed that the said claims are unpatentable in view of the following prior patents and for the reasons given in the statement of the examiner in answer to the appeal and the decisions of the Board of Appeals, copies of which will be furnished at the trial:

Wilson,	533,938, Feb.	12, 1895,
Hewitt,	799,052, Sept.	12, 1905,
Kraus,	1,046,086, Dec.	3, 1912,
Slepian,	1,932,090, Oct.	24, 1933,
De Forest,	2,110,759, March	8, 1938,
Van Meyl, French	593,863, June	6, 1925,
Hauser, British,	379,337, Aug.	26, 1932.

8 Proffer of copies of these patents is hereby made.

W. W. COCHRAN
Solicitor, U. S. Patent Office,
Attorney for Defendant.

August 26, 1941.

I hereby certify that a copy of this ANSWER TO THE COMPLAINT was mailed today, August 26, 1941, to the attorney for plaintiff, Thomas J. MacKavanagh, Munsey Building, Washington, D. C.

W. W. COCHRAN
Solicitor.

Appearance

I hereby enter my appearance as additional counsel for plaintiff.

DONALD J. SIMPSON
53 West Jackson Boulevard
Chicago, Illinois
Tel: HARrison 6150

Washington, D. C.
June 16, 1942

Service of a copy of the foregoing appearance acknowledged this 16th day of June, 1942.

W. W. COCHRAN
Attorney for Defendant.

Findings of Fact

1. This is an action brought under the provisions of Section 4915 R. S. (U S C Title 35 Section 63) in which it is sought to have this court authorize the Commissioner of Patents to issue to the plaintiff, as the assignee of Foster B. Doane, a patent containing claims 17, 18 and 19 of the application of the said Doane, No. 269,644, filed April 24, 1939 as a continuation-in-part of application No. 27,756, filed June 21, 1935.

2. The Doane application relates generally to magnetic testing of steel articles for the purpose of ascertaining whether defects exist therein, and, more particularly, to the magnetization of such articles by alternating electric current.

Such testing is made by magnetizing the articles and then applying thereto finely divided particles of para-magnetic material, such as iron filings, which tend to adhere to the magnetized articles in the region of the defects.

11 In the apparatus of the Doane application the article is placed in magnetizing relation to an alternating current circuit, in which there is a switch of such a character as to interrupt the current flow at substantially the zero point of the current, at which time there will be a sub-

stantial magnetization of the article. The application discloses two forms of the switch, one of which is the mercury switch and the other a de-ionizing switch, commercially known as a "Deion Contactor". The specification states that opening of the current path to break current flow by means of a manually operated switch is uncertain, and there is no assurance that the test piece will be left magnetized. The specification also states that one of the characteristics of a mercury switch is that the current is broken at the end of a half cycle, or when the current reaches zero value.

3. The French patent to van Meyl, No. 593,863, published September 1, 1925, discloses means for magnetizing permanent magnets by using alternating current, the article to be magnetized being placed in proper relation to a coil connected to a source of alternating current, through an automatic interrupter such as a fuse. When the circuit is closed by a push button, a heavy current flows through the magnetizing circuit including the fuse, which it is stated
12 "seems always to interrupt the circuit when the field intensity is near maximum". It is further stated that other automatic circuit breakers may be used in place of the fuse.

4. The British patent to Hauser, No. 379,337, published August 26, 1932, shows an apparatus for magnetizing articles by the use of an alternating current. In the device of this patent, the switch in the magnetizing circuit is controlled by a polarized relay in a shunt circuit with the magnetizing circuit. This relay is so arranged in relation to a permanent magnet as to insure that the article will be magnetized with the proper polarity.

In the specification of the British patent the following statement is made:

"This invention relates to a magnetizing apparatus for operation with alternating current. In magnetizing devices the coils of which for the generation of the magnetizing field are supplied with alternating current it has hitherto proved a matter of difficulty in the first place to utilize

the greatest strength of the alternating field for the magnetizing process, and secondly to determine in advance the polarity of the object to be magnetized. With a hand operated switch it is obviously impossible to effect with any certainty the interruption at the right moment of the alternating current traversing the magnetizing coils. But even interruption at the neutral point, as already proposed for the primary circuit of a transformer fed with alternating current, which could also be used as a magnetizing apparatus, merely ensures the interruption at a moment at which the field of the secondary winding possesses its maximum strength, but not the attainment of the desired polarity in the object to be magnetized."

13 5. The patent to Wilson, No. 533,938, the patent to Hewitt, No. 799,052, and the patent to Kraus, No. 1,046,086, each discloses a mercury switch and the Kraus patent states that such a switch will interrupt the alternating current at the zero point of the current.

6. The patent to Slepian, No. 1,932,090, discloses a "Deion Contactor" such as used in one of the forms of the device shown in the Doane application. This device causes the interruption of the current at the zero point of the current.

7. It was not invention to substitute for the polarized controlled relay of the British patent to Hauser a mercury switch, such as shown in the patents to Wilson, Hewitt and Kraus.

8. It was not invention to substitute the "Deion Contactor" of the Slepian patent for the polarized relay controlled switch of the Hauser British patent.

9. Claims 17, 18 and 19 of the Doane application, involved in this suit, define no invention over either the French patent or the British patent, in view of the prior art.

Conclusions of Law

1. The plaintiff is not entitled to a patent containing claims 17, 18 and 19, or any of them, of the Doane application involved in this suit.

2. The Complaint should be dismissed as to all of the claims presented therein.

July 15-1942

DANIEL W. O'DONOGHUE

Justice

14

Judgment

This cause having come on to be heard and having been tried in open court and argued by counsel for the respective parties upon the pleadings and proofs adduced and submitted to the Court,

It is ADJUDGED this 15th day of July, 1942, that the complaint in this case be, and the same hereby is dismissed with costs against the plaintiff.

DANIEL W. O'DONOGHUE

Justice

APPROVED AS TO FORM:

DONALD J. SIMPSON

Attorney for Plaintiff

15

Notice of Appeal

Notice is hereby given that Magnaflux Corporation, the plaintiff above named, hereby appeals to the United States Court of Appeals for the District of Columbia from the Judgment entered in this action on July 15, 1942, which dismissed the complaint in this case.

CHARLES W. HILLS, JR.

DONALD J. SIMPSON

53 West Jackson Boulevard
Chicago, Illinois

THOMAS J. MacKAVANAGH

Room 633 Munsey Building
Washington, D. C.

Attorneys for Plaintiff

Dated: August 19, 1942

16

Order

Upon Notice of Appeal filed in this cause, it is Ordered that the amount of the appeal bond be fixed at \$100.##; or in lieu thereof a cash bond of \$100.## to be filed with the clerk of this court.

Dated: August 10, 1942.

DONOGHUE

Justice

Amount consented to
by attorney for defendant

8/10/42 A. L. C.

Memorandum

AUGUST 14 1942

Deposit by Simpson \$100.00 in Lieu of Bond on Appeal.

II.

TESTIMONY AND PROCEEDINGS.

17 Endorsed: Filed Sep 2 1942 Charles E Stewart,
Clerk

Transcript of Proceedings

District Court of the United States
for the District of Columbia

Civil Division No. 6

MAGNAFLUX CORPORATION, *Plaintiff*,

v.

CONWAY P. COE, COMMISSIONER OF PATENTS, *Defendant*.

Civil Action No. 12,438

Before Mr. Justice O'Donoghue

Washington, D. C.

June 17, 1942, 10:20 a.m.

Appearances:

Donald J. Simpson, Esq.,
Attorney for Plaintiff

Robert F. Whitehead, Esq.,
representing W. W. Cochran, Esq.,
Solicitor for the United States Patent Office

Mr. Simpson: May it please the Court, this is a suit in equity against the Commissioner of Patents which arose because of a refusal by the Patent Office to grant a patent on an application which is owned by the Plaintiff.

Jurisdiction is based on the provisions of Section 4915 of the revised Statutes, the present suit having been
18 filed within six months after the Board of Appeals of the Patent Office affirmed the earlier decision of the primary examiner, denying a patent.

The evidence presently to be offered in this case will show that on June 21, 1935, an application for patent entitled "Improvement in Process of Magnetizing" was filed in the United States Patent Office by Foster B. Doane and was assigned Serial No. 27756. At a later date and while this application Serial No. 27756 was still pending, an application for patent entitled "Magnetic Testing Method and Means" was filed in the United States Patent Office on April 24, 1939, by Foster B. Doane and was assigned Serial No. 269,644. This second application was a continuation in part of the earlier application Serial No. 27756, it having been based in part on the original disclosure of the earlier application.

An assignment dated April 21, 1939, transferred the entire right, title and interest in and to this application to Magnaflux Corporation, the Plaintiff in the present case. This assignment was recorded in the United States Patent Office on April 24, 1939 and was entered as Document No. 59505, Liber B-179, page 209.

This Doane application, Serial No. 269,644, describes a novel method and means for non-destructive testing of magnetizable metal objects to determine the presence of surface or subsurface defects. For example, there are a very
 19 large number of steel and other ferrous parts which are used in industry, which are used in the automobile industry, which are used in the airplane industry, and the railroad and many other industries, and it is extremely important that these parts shall not fail in active use. It is quite obvious that if parts of an airplane should fail when the plane is in the air, that a crash might occur; and all of industry has had to devise some way of checking the use of the steel parts which they have.

There are several different types of flaws which occur in steel parts. One type is due to the structure of the part itself; slag or something may be caught up when the metal is being molded or formed. You have some types of cracks and defects that develop; when a part is being machined

by a machine tool, the temperature of a part rises and very minute cracks may develop.

It very frequently happens that these defects, these cracks, will develop in such a way that it is impossible to see the presence of the defect with the naked eye, and indeed in many instances a very serious flaw may exist in the article and you would still be unable to see this defect through a microscope.

There have been in the past a number of different ways developed to check metal objects, metal parts, for the presence of flaws. Some of them, for example, such
20 as the acid etch method, require dipping the part in a strong solution of acid. There are other tests of this type that cause an abuse or even a destruction of the part itself, so that if you have maybe a thousand parts coming off the assembly line, you arbitrarily test two or three of the parts and draw your conclusions with regard to the test from those two or three parts. That, of course, is not a very satisfactory method of test because you may have a defect in one of the parts that wasn't arbitrarily picked out. You can't draw any sweeping conclusions as to an entire batch from the examination of two or three.

There are other tests, and one in particular, which is known as a non-destructive test for flaws. By that we simply mean that we can run a test on a particular part without in any way marring or hurting or destroying the part itself, and a test of that type lends itself to checking every single part as it comes through the assembly line, or the part is tested after it has been in use for some time.

The Plaintiff in the present case, Magnaflux Corporation, is one of the leaders in industry in this field of providing equipment for non-destructive testing of steel and other ferrous parts. It was determined very definitely a number of years ago that if a steel part were magnetized and then iron filings or powder which is paramagnetic in character, that is capable of being magnetized, were sprinkled on the
21 part, these particles of this paramagnetic powder would congregate or become more dense over a sur-

face or a subsurface defect. That provided an easy way to check the part because it was simply necessary to pass a part through a magnetic field, or to permanently magnetize it and then sprinkle this powder onto the object and note whether there were any particular groupings of these particles. If there were, it indicated the presence of a flaw, and if not, it indicated that the part was free from flaws.

These first devices used direct current to magnetize these steel parts. There were two or three different convenient ways that they could magnetize these parts and they would magnetize them in different ways to detect flaws which might run in different directions. For example, if the part were put in the center of an electric coil and were magnetized, the lines of the magnetic force would pass longitudinally through the part; that is, longitudinally through the coil. If they passed current itself directly through the part, from one end to the other, you would get what is known as circular magnetism, which merely means that the lines of the magnetic force would go circumferentially around the part. As we shall presently bring out and as will become more apparent from the testimony and the exhibits which we shall offer in this case, the presence of a longitudinal crack would show up when circular magnetism is used, and the presence of a crack extending circum-

22 ferentially around the object would show up when longitudinal magnetization was placed in the object.

The present application deals with a step forward that was taken in this art, and that was to use alternating current rather than direct current for magnetizing the object. There are many things in electrical science in which alternating current and direct current may be interchanged and the same results obtained. There are many other things in the electrical sciences in which these two different types of electric energy may not be interchanged. As we shall presently point out, by the testimony which we shall offer in this case, there were some peculiar problems in this field which

for many years prevented anyone from using or from wanting to use alternating current to permanently magnetize an object for flaw detection purposes. The reason for that is that there was great uncertainty as to whether the object would be magnetized and left in a magnetized state by the alternating current after the current was broken.

As we shall point out and endeavor to make clear to this Court, it is extremely important where and how you break the alternating current. If you break it in certain ways, you get no magnetism left in the object. The result is that if you were checking a part for flaw and you weren't certain whether the object had been magnetized or not and you sprinkled the powder onto the part and did not notice any

particular collection of particles at any one point,
 23 you would be unable to draw a conclusion as to whether the part was free of flaws or merely that it was not magnetized properly. We thus have a problem in the field of magnetic inspection of parts for flaws in which the equipment must work 100 per cent of the time. Now that is extremely important in this case. If it fails once in a hundred times, you may have a key part in an airplane that will have a flaw in it, which you believed was safe but which in fact had a serious flaw in it.

The teaching of this application which is involved in this present suit is that when you use alternating current permanently to magnetize an object for flaw inspection, you must interrupt the alternating current in a particular manner in order to have the dependability which is absolutely necessary in flaw detection apparatus.

Now, the present applicant recognized this problem, that it was necessary to provide some type of apparatus in which uniformity was always obtained, in which you would always get substantially the same amount of magnetism left in the part after the current was broken.

He further went on and found that if you provide a magnetizing circuit arrangement in which the current is always interrupted at substantially the zero point of the current

wave, this result would be obtained. The claims that are involved in the present suit define the circuit arrangement and the type of interrupting means which will always
 24 insure an interruption at the zero point of the current wave and will consequently always insure the one making the test that the necessary and required amount of residual magnetism is in the part to be tested.

In the disclosure of this application there are two different types of circuits illustrated and described which will bring about this result. One of the circuits includes the use of a mercury switch in the energizing circuit of the magnetizing means. The second circuit arrangement includes the use of what is known as a de-ion circuit breaker. Both of these types of interrupting means provide a circuit arrangement which will bring about this result which I have just described to you.

I might make it clear at this time that this present applicant was not the first person to attempt to use alternating current to effect permanent magnetization of objects. You will see from the references relied on by the Patent Office that efforts were made to permanently magnetize horseshoe magnets. We draw the distinction, however, that alternating current was not used in any place where reliability and dependability were essential. You will find from one of the references that describes using alternating current for magnetizing a permanent magnet that they point out if it doesn't magnetize it the first time, magnetize it again. If
 it is the wrong polarity the first time, try it again.

25 We can't do that in any magnetic test equipment because the first time must be the right time.

The references which are relied on by the Patent Office showed that mercury switches in general were old, not in this type of environment and not in this combination, but mercury switches by themselves, mercury switches in alternating current power lines, were old. De-ion circuit breakers were old. But nowhere in the prior art do we find any teaching or any understanding of the requirements

which are necessary for the use of alternating current in a magnetic test apparatus. Nowhere do we find the use of a mercury switch or a de-ion circuit breaker in a magnetizing circuit, irrespective of what it is magnetizing.

It is very interesting to examine the statements which were made by the Examiner in his formal Examiner's Statement to the Board of Appeals. It is very interesting to examine the statements which were made by the Board of Appeals in rendering their original decision, and again in rendering their decision on request for reconsideration. An examination of these records will show that the Board of Appeals felt that if this applicant were the first to recognize certain facts, then there was some evidence of patentability in the claims which are here involved. Then they go on and they predicate their conclusion on the ground that

26 "Because we believe that the teachings of a certain British patent and the teachings of a certain French patent suggest and show this feature, we are led to the conclusion that there is no patentability."

Now we are going to show by the evidence which we will offer in this case that the Board of Appeals was predicating their conclusion on a misunderstanding of what these prior art references show. We are going to show that their conclusion was predicated on a false premise.

One statement that the Board of Appeals made is particularly interesting. They pointed out that "If appellant was the first to recognize that a magnetizing circuit could be opened at the zero point without sacrifice of magnetizing efficiency, there might be some element of patentability in the subject matter appeal." We are going to show by our evidence that the appellant was the first to recognize that a magnetizing circuit could be opened at the zero point without sacrifice of magnetizing efficiency. We are going to go even farther than that. We are going to point out that not only can they do it without a sacrifice of magnetizing efficiency, but that they can do it with great gain in magnetizing efficiency.

I call your attention to another statement by way of example that the Examiner relied on in arriving at his conclusions in the matter. The Examiner pointed out that "The distinction that we find in the present application appeared to be nothing more than an obvious equivalent
 27 of the automatic interrupter of Hauser and Van Meyl without utility or benefit and constituting rather a disadvantage by loss of energy and time and advantage." The evidence presently to be offered will show conclusively that the present invention is not the obvious conclusion of Hauser and Van Meyl, and will furthermore show, instead of being a disadvantage, is a very marked and distinctive advantage over the system shown.

There are other statements that have been made by the Board of Appeals, and I take this opportunity merely to call these points to your attention because I think it shows rather clearly that the Board of Appeals felt that they had to predicate this decision on certain stated understandings of what these references show, and I think that they were rather clearly qualifying their opinion on this understanding of what these references show.

The Board of Appeals pointed out also——

The Court (Interposing): Don't you think it would be well for us to hear the testimony and enter these exhibits, and then go into the decision of the Board of Appeals in the argument? What I want in the opening statement is what you expect to prove, and then take that up in the argument.

Mr. Simpson: All right. That will conclude my opening statement, then.

Mr. Whitehead: The decisions in this case are based not on lack of novelty or lack of utility, but are based
 28 on lack of invention, on the ground that there was no invention in using the mercury vapor switch or switch of that type to break the current in a magnetizing circuit. It was a known characteristic of the circuit breaking switches the the voltage of the current came down to

zero. It rises and falls and goes from maximum down to zero, and the point of that is that these mercury vapor switches are shown by the references to have a characteristic that they do break the current at the zero point, and that is so stated specifically in the application here in the suit.

These two foreign patents are for using alternating current for magnetizing objects. The one patent states specifically that in view of using a fuse which blows out, they can use automatic interrupters; and in this British patent it is specifically stated that it was known that if the current was interrupted at zero point, there would be a maximum of magnetization. But it goes on to point out that the particular device he uses didn't use that device for breaking at zero for an entirely different reason, because he wanted to accomplish another object. The Board stated in so many words that in view of the Hauser British patent and its description, there was no invention in substituting the mercury vapor switch for the other type of interrupter. That is the point of the case.

I call your attention to the fact that in the claims
 29 in this case, the first claim defines it not as a mercury vapor switch but defines it rather by functional statements, but those statements all apply to a mercury vapor switch. The next claim uses the same language but specifies that the switch is a mercury vapor switch; and the third uses substantially the same language and specifies that it is a de-ionizing switch. Those types of switches are all well known, as shown in the Examiner's report.

I am not going to go into details, but I will say that that is broadly stating the reason for the refusal to grant patent.

The Court: Were any claims allowed?

Mr. Whitehead: No, sir, no claims were allowed. There were only three claims that were finally presented and rejected by the Examiner. Those were the only claims in the case and no claims have been allowed.

Mr. Simpson: I wish to offer in evidence a certified copy of the Doane application, Serial No. 269,644 as Plaintiff's Exhibit 1.

(The certified copy of the Doane application, Serial No. 269,644 was received in evidence and marked "Plaintiff's Exhibit No. 1.")

Mr. Simpson: I wish to offer a certified copy of the Doane Application, Serial No. 27756 as Plaintiff's Exhibit 2.

30 (The certified copy of the Doane application, Serial No. 27756 was received in evidence and marked "Plaintiff's Exhibit No. 2.")

John E. Clarke, called as a witness in behalf of the Plaintiff, being duly sworn, testified as follows:

Direct Examination

By Mr. Simpson

Q. 1. What is your age and residence, Mr. Clarke? A. My age is 38 years. My residence is 6473 North Newark Avenue, Chicago, Illinois.

Q. 2. What is your present occupation? A. My present position is with the Magnaflux Corporation, 5908 Northwest Highway, Chicago.

Q. 3. What is your official position with that company? A. My official position is assistant to the Vice President and General Manager. My duties are actually to take charge of electrical research and production.

Q. 4. Whom were you with before you became associated with Magnaflux? A. Prior to coming with Magnaflux, I was in the Lynch Corporation in Anderson, Indiana.

Q. 5. What were your position and duties there? A. My duties there consisted of experimental electrical and electronic engineering and a certain amount of mechanical design.

31 Q. 6. With whom were you connected before that? A. The Merz Engineering Company in Indianapolis, Indiana.

Q. 7. And what were your position and duties there? A. Practically the same as at the Lynch Corporation.

Q. 8. Will you state the approximate dates that you were in the Merz Company? A. I was with them from early in 1935 to sometime in 1937.

Q. 9. And how long were you with the Lynch Company? A. From '37 to '38, not quite a year, but between those dates.

Q. 10. And how long have you been with Magnaflux Corporation? A. Since leaving Lynch in 1938.

Q. 11. Will you state with whom you were connected and what business you were in prior to the time that you were associated with Merz? A. Prior to that time I was in the radio business in Bloomington, Indiana.

Q. 12. How long were you in that business? A. Eight years.

Q. 13. What did you do in connection with that business? A. Radio service work in general, and especially design and construction of special amplifying equipment or rather electronic or electrical devices.

Q. 14. What university did you attend? A. Indiana University, Bloomington.

Q. 15. Have you ever been connected with any school or trade school in the capacity of instructor? A. At the present time I am an instructor in the periodic trade schools given by the Magnaflux Corporation.

Q. 16. What subject do you teach? A. General magnetic theory.

Q. 17. Have you ever written or collaborated in the publication of any textbook or article? A. I collaborated in the publication of the book entitled, "Principles of Magnaflux Inspection," by F. B. Doane.

Q. 18. What is the general subject matter of that book? A. The book in general deals with the general application of the magnetic inspection method known as Magnaflux, and applies not only to applications and use of the equipment, but also to the theory of operation.

Q. 19. Will you tell the Court briefly some of the essential requirements of quality in steel parts? A. In designing a part that is to make use of steel, there are a number of things, a number of characteristics of that steel that have to be taken into consideration. Strength of the steel, for instance, has to be taken into consideration to determine the size of the part, the cross-section that it will have to have when it is built into a finished machine or device, and certain other properties. As far as the strength of
 33 the material itself is concerned, a great many years of experience and investigation have enabled the engineering profession in general to set up tables and get together a large amount of knowledge in regard to strength of these different materials, and it is from information such as this that design is made.

All these tables and all this information are, of course, predicated on the assumption that the steel that is used will be sound. In other words, if a steel of a certain type is supposed to have a certain strength, that is the strength for a sound piece, a normal piece, but is not representative at all of the strength of a piece that has a considerable flaw in it.

Q. 20. What are some of the principal types of flaws and defects found in steel? A. A few of the most common are non-metallic inclusions, which are quite common. What I mean by that is this, that in the fabrication of the steel, most generally by rolling, there will be a small amount of slag or non-ferrous material, material that isn't iron or steel itself, present, and when that is rolled out, it will be included in the steel and constitute an area of different characteristics from the main body.

There are other defects, such as porosity or pinholes which are actually small voids, generally occurring
 34 in castings and the like.

Then there are other defects that can come in, not from the original material itself, but can come in fabrication. A common one of these is a crack that is due to the

heat treating or tempering of the material. A material that is perfectly sound, when it is heat treated, will come out of heat treat and eventually develop a large number of fine surface cracks due to this heat treating.

There are also defects that can be caused by other fabrication porcesses. Grinding especially quite often causes defects.

Q. 21. Tell the Court the principal ways in which steel parts may be tested in order to detect the presence or absence of flaws and defects. A. There are several different ways that have been relied on in the past. One that was used quite extensively, and still is in certain applications, is etching by means of an acid or other corrosive bath. In this the part is placed in a bath of corrosive material and this material is allowed to attack the surface. Any defects then will be shown up more plainly due to the fact that the acid will attack the edges of voids, if there happen to be voids there, or by the choice of bath certain included materials can be dissolved out, you might say.

Another test method that is made use of quite
35 often is x-ray. It merely consists of exposing the part to the rays from an x-ray tube, or of course other similar radiation, such as gamma rays, etc., and actually taking a photograph of the interior of the part, and of course some of the exterior surface is shown up there, too.

There are two magnetic systems of testing. One of them is normally spoken of by its trade name as Magnetic Analysis, and the principle in it is that a uniform part, a part of absolutely uniform cross-section, is fed through a series of magnetizing coils and the feed must be accomplished at a uniform rate, also. Then if there are defects in this which cause changes in permeability, it induces voltages in a certain arrangement of pick-up coils that record on instruments.

A fourth method is the Magnaflux method which makes use of the method of actually magnetizing the part and

setting up fields in it in a number of different directions, either simultaneously or one after the other, and then applying an indicating medium which is a dry, finely divided paramagnetic powder or one where the paramagnetic particles are held in suspension in a liquid.

Q. 22. Upon what principles is the Magnaflux method of testing based? A. It is based on this principle, that if a part is magnetized in a direction that the general direction of the lines of force in the piece are parallel to the surface, those lines of force will actually assume that direction so long as that piece is sound, but if there are defects of any sort present to upset this path or make a change in its permeability or the ease with which these lines of force travel through the material, then there will be a distortion of the field resulting in a leakage of lines of force to the outside.

Q. 23. You handed me some photographs before we came here this morning. Will they assist you in your explanation? A. They will.

Mr. Simpson: I will offer this as Plaintiff's Exhibit 3 as illustrative of the testimony.

(The photograph was marked "Plaintiff's Exhibit No. 3 for Identification.")

A. This particular photograph shows very clearly the distribution of the lines of force outside a piece of material that is magnetized. It is what is spoken of as being a magnetograph. It is made by actually magnetizing a small bar of steel which is indicated here by the white oblong section in the center. After that piece is magnetized it is placed in a horizontal position on a table or other flat surface and a piece of white cardboard placed over it. After this cardboard is in place, then magnetic particles are dusted onto that cardboard; in this case probably iron filings were used. A slight tap on that card then renders those particles free to move and they move to where they arrange themselves along such pattern as is seen in this picture.

Those lines of filings in this photograph have arranged themselves so that they follow, in general, the lines of force which are set up in the air surrounding this magnet by the influence of the magnet itself. Actually, if it is examined closely you will see that lines emerge from one end, and getting pretty well to the edge of the photograph, they return and double back onto themselves and back into the magnet. The theory, of course, is that those lines of force are completely closed lines and that they leave from one end of the magnet, return to the other end, but continue on through the material itself.

Q. 24. Will you now describe what happens if the magnet is broken in two? A. The second photograph will aid in that.

Mr. Simpson: I will offer the photograph that he is now referring to as Plaintiff's Exhibit 4.

(The photograph was marked "Plaintiff's Exhibit No. 4 for Identification.")

A. In this photograph a magnet similar to the one shown in the first picture has been broken in two and the edges of the break separated slightly. We now see that we have two separate magnets there which are very similar to the one in the first case, each having its own field about it with the lines of force leaving at one end and tending to come back in or reenter at the other end. However, now
38 at the space between these two magnets, the separation at the break, we will call it, we will notice that there is a very heavy concentration of these lines of force. In other words, they are very dense between those two parts. We have two magnets here that exhibit practically normal characteristics excepting in the small space between them, and there we have a more intense field set up.

Q. 25. Will you now explain what occurs when a crack occurs in a long bar?

Mr. Simpson: Let the record show that I have handed the witness a photograph which we will mark Plaintiff's Exhibit 5.

(The photograph was marked "Plaintiff's Exhibit No. 5 for Identification.")

A. In this particular photograph, this is another magnetograph that was made in the same way. The part in this case was actually a hack saw blade. The part being quite thin, it could easily be placed in a vice and was bent forward and back until it snapped part way through. In other words, at one side there is an actual crack in the material but it doesn't extend all the way across, so that the part isn't entirely separated.

This actually represents an intermediate case between the first two photographs. In one section of the material, the material is complete, that is, it is unbroken, but
 39 at the other side there is a break in the path. Where we have this crack, we get a heavy concentration of lines of force extending up from the edges in the same manner that we had where the two magnets are separated in the second photograph we used, and you can notice that there is an accumulation of the powder particles right around that crack itself, at the edge of the blade.

Q. 26. I hand you another photograph and ask that it be marked Plaintiff's Exhibit 6 for Identification.

(The photograph was marked "Plaintiff's Exhibit No. 6 for Identification.")

A. This is a drawing or diagram which will indicate more clearly what the photograph previously discussed was intended to show. In this particular case, a small section from the center of a magnetized piece is assumed, the lines running parallel to the center and between the edges of the piece indicating the magnetic lines of force. In this particular case, it is assumed that there is an actual void in the material; in other words, a crack extending from the surface toward the center of the part, and we can see from this diagram that there is a distortion of the field in the piece.

At the center there is a slight amount of distortion. That is marked "a" on this diagram. There is a small distur-

tion near the center of the piece where the lines of force are caused to deviate slightly from their regular path,
 40 to go around the crack due to the change of its permeability. Of course, in magnetic testing we are not much interested in that because it is inside the piece and we can't get an indicator down there to tell anything about it.

At the surface, though, there is a considerably larger distortion, and if we will notice, only at the center of the cracked part itself the lines of force are straight, but if we come up to the top they start to curve more and more to the outside, and eventually when we have actually gotten to the surface of the piece the lines of force are leaving and escaping into the air on one side of the crack and returning to the air on the other side.

Wherever these lines of force escape into the air or return back into the material, they set up what are generally spoken of as magnetic poles and those poles exhibit the characteristics of attracting certain types of material to them, such as iron parts, in much the same way as the poles of the horseshoe magnet. So in this case we have set up a field at the edge of this crack which is centered on that crack, and we could show its location and its direction if we could consider another plane at right angles to this. But in addition to that, it has also magnified that in size. In other words, the field is considerably wider in extent than the actual crack itself.

Mr. Simpson: I offer that photograph which was
 41 marked "Plaintiff's Exhibit 6 for Identification," as Plaintiff's Exhibit 6.

The Court: Why don't you just offer them in evidence as they are presented? It will save time. All of these that you have offered up to and including 6, are admitted in evidence at the present time.

(The photographs marked "Exhibits 3 to 6, for Identification," were received in evidence as "Plaintiff's Exhibits No. 3 to 6," inclusive.)

Q. 27. Did you bring with you anything with which you could make a visual demonstration to the Court of the presence of a flaw or defect in a metal part? A. I did, yes.

Q. 28. Will you demonstrate to the Court how a test for flaws may be made on that part that you have? A. To conduct a test for flaws on this particular part, there would necessarily be two actual test steps performed. However, one will illustrate just what is done. We will assume that we want to test this part for defects which are of a transverse nature; in other words, defects that will run circumferentially around the piece. To do that, we wish then to set up a magnetic field in the piece so that our lines of force are longitudinal with the piece; in other words, parallel to the axis. That can best be done by placing the part in a coil and passing current through the coil.

42 If proper conditions are adhered to and we have passed this current through the coil and had the piece inside it, the piece will be permanently magnetized and will actually have poles at the end and it is very similar to the bar magnet that was discussed sometime ago.

Q. 29. Have you caused that piece that you have in your hand to be magnetized? A. I have. It is in a magnetized condition now.

Q. 30. How was it magnetized? A. It was magnetized by placing it in a coil and passing an alternating current through that coil and interrupted in a proper manner to leave a residual field in the piece.

Q. 31. What was used to interrupt the current? A. A de-ion type breaker.

Q. 32. Will you now spray some powder on that piece and determine whether there is a flaw? You might tell the Court what that is you have in your hand. A. In this small shaker or applicator I have what is commercially known as Magnaflux Powder No. 1. It is a gray colored powder which is especially prepared for use in this magnetic test of steel parts. It is a commercial product and the product that is used normally in a large number of cases. To bring

out the presence of any defects on this piece after it has been magnetized, this powder can be applied all over
43 the surface and any excess removed either by tapping it lightly or by a mild blast of air, and after that, where the material is free at the sound portions, the powder will fall free, or at least most of it, but there will be a heavy accumulation where there is any defect present, and it will be held tenaciously enough that the tapping or the blowing will not take it off.

The powder now is being held on there. You can see now there are a large number of very fine deposits of that powder on there. Those run generally around the piece, circumferentially in a slightly spiral direction. That is the powder that is held. It can be rubbed off.

Q. 33. Do those concentrations of powder in those lines indicate the presence of a flaw? A. Yes, they do.

Q. 34. You would say, then, that this piece has a number of flaws in it? A. I would.

Mr. Simpson: I offer this in evidence as Plaintiff's Exhibit 7.

(The steel part used in the demonstration was received in evidence and marked "Plaintiff's Exhibit No. 7.")

Q. 35. Will you tell the Court the theory underlying the detection of subsurface flaws? I hand you here a photograph and I offer this photograph in evidence as
44 Plaintiff's Exhibit 8.

(The photograph was received in evidence and marked "Plaintiff's Exhibit No. 8.")

A. This is another diagram that is made up in the same manner and for the same purpose as the one which I believe is Exhibit 6. However, in this case it is assumed that the defect does not extend through to the surface as it did in the first case but only extends up to the proximity of the surface.

You will note that inside of the piece, relatively close to the center, our lines of force are straight, as they were before. What I am referring to here is the center of the defect

itself which is shown in the double line between "a" and "a." At the center of the material itself, we have a slight deflection, as was present before, and at the outside edge we have another case where there is a greater distortion; lines of force are forced out of the general direction which they normally are taking through the piece and certain of them escape into the air and return again, giving the same type of field that shows the location of a defect but exaggerates its size. This is intended to show that even though the defect does lie beneath the actual surface of the piece, a defect can be shown up by this same method.

Q. 36. Will you explain the magnetic changes which occur in a paramagnetic object when it is subjected to the
45 influence of a reversing magnetic field?

A. To do that, I would like to have the use of the blackboard.

In the first place, the magnetic field of a piece is generally spoken of, as far as its intensity is concerned, as being of the strength of so many lines of force per unit area of square centimeters or square inches, or as the total number of lines of force which are present in the whole material. To set up a field in a piece, it is necessary to apply some sort of magnetizing force or a force which is capable of instigating this field in the material. One of the simplest ways of doing that is by means of an electric current and it can be applied in a number of different ways, either by passing it directly through the material or by passing it through an electric circuit which is associated with the material in the proper manner to produce magnetization. But regardless of the method of the circuit arrangement, your magnetizing force will in all cases be proportional to the actual electric current that is flowing, if other conditions remain fixed. In general throughout any discussion here, I believe we will be entirely safe in assuming that magnetizing force and current are interchangeable terms.

(Drawing) To indicate how a magnetic field builds up a material and to indicate certain magnetic characteristics of

that material, a curve or graph is generally drawn in
 46 which we can build up part by part here and which
 will make it somewhat easier to understand. In
 building up a graph of this kind, the magnetizing force,
 which we have said is proportional to current, is generally
 plotted along a horizontal axis and is indicated by a script
 or Old English H, and we can indicate that $H = \text{current}$.

On a long vertical axis we plot the field strength that is
 actually set up in that piece. That is mostly indicated by
 a script or old English B. We will say that is the magnetic
 flux in the piece. That is our magnetizing force and this is
 the magnetic flux that that magnetizing force sets up in the
 piece.

To get a complete picture, we can start with the material
 in an unmagnetized state, having no magnetization at all.
 We will also start with that magnetizing force at zero.
 That makes the first point on our curve come at the origin.
 If we start building up our magnetizing force or our cur-
 rent in small increments, equal increments, we will see that
 at first the field in that piece builds up very gradually and
 after a while the rate of build-up starts to increase and gets
 quite steep. Eventually, then, after we have applied a
 certain amount of magnetizing force, this curve starts to
 drop off and eventually come back to a place where it has
 reached a horizontal point.

Just to interpret that part of it, it means this:
 47 If to a material that is unmagnetized you apply a
 certain amount of magnetizing force, the first incre-
 ment will produce very little magnetization. Each succes-
 sive one will produce accordingly a somewhat greater
 amount until we get in here, where each variation in the
 curve will produce rather large amounts of increase in the
 magnetization of the material, until we get up to a point
 like this, then the same increments will produce consider-
 ably lower amounts of magnetization and finally when this
 curve has become horizontal, no amount of magnetizing
 force will increase the field that is in that piece any fur-

ther. Our field is horizontal and we can build this up as far out as we want to and there is no more field added to the part being magnetized.

If we start to drop back on that, there is a rather interesting set of conditions. In the first place, the field that is in that piece does not drop back along the same path which it increased. In other words, it deviates from this line and actually remains above. We can speak of it as lagging behind. In other words, in the first case this point right here produced this much magnetization in the piece. When we have returned to that, we have gone out in this direction now and built up a magnetizing force which corresponds to that. For convenience, let's label those positive and negative, and up here we will consider our flux as being in a positive direction and down here as negative.

48 When we are coming up to this, this much magnetizing force has produced this much field in the piece, but in dropping back and coming to this same volume, we have a considerably larger magnetization. If we keep on coming back on that, our line straightens out and eventually we get a point like that.

Then we come to a point where we have no magnetizing force applied to that piece whatever, but there is a field left in it. We can call that point "A." The distance to "A" represents the actual amount of magnetization left in that piece after we have built it up to this point and reduced it back to zero. If we continue to reduce that, further reduction now actually amounts to a reversal in direction and an increase of current in the opposite direction. If we start to build up our negative current, then we will find that this curve will extend on across in some such manner as this until we finally get to another place where we have the condition that there is no field in the piece but we have magnetizing force applied which is almost in reverse of O-A. O-A is actually spoken of here as being indicative of the retentivity of the material. It actually is an indication of the remanent of the field.

If we continue on from this, we will find that we have crossed the zero point now and our field starts to build up at a rather rapid rate and then gradually levels off again to the horizontal position much the same as it had before, and if this were accurately drawn the points where these level off should be approximately the same in either case; in other words, the same amount of magnetizing force regardless of direction would produce the same amount of field in the piece.

If we start to reduce this current, it comes on back and reduces according to this same line up here. In other words, that will bring us up to a point on the curve somewhat like that, and we call it A', and again we have a remanent field in the piece with no magnifying force applied and that value O-A' is the same as O-A up here, but in the opposite direction. Continuing, then, we close up a curve that will come across our zero flux axis at some place like this and will eventually close itself up this way. If that same cycle is continued it will not come back along this path but it will reverse that whole curve just around the outside interval.

That has sounded quite slow and I realize it took up quite a bit of time, but that same cycle is gone through in the case where alternating current is used for magnetization, once each cycle of current. In other words, in a 60-cycle current, which is a commercial current, that cycle is actually gone through in the iron sixty times every second.

Q. 37. I now show you a chart which is labeled "Chart Illustrating Difference in Amount of Residual Magnetism with Alternating Current Broken at Different Points of Current Cycle," and ask you if you recognize it? A. I do.

Q. 38. Did you cause this chart to be made pursuant to your directions and under your supervision? A. I did, yes, sir.

Q. 39. Referring to this chart, I will ask you to explain to the Court what takes place if the magnetic force respon-

sible for setting up the field is instantaneously interrupted at certain particular points around the hysteresis loop. A. This is a diagram of a hysteresis loop very similar to the one which I developed on the blackboard. In this particular one we considered carrying the current up to the maximum value in one direction, reversing it and carrying it down to a maximum in the opposite direction. Now if that magnetizing force were removed by that current, the effect of that current's being interrupted at any point on this curve, the actual point where the interruption takes place will determine just what does happen. There have been a number of points taken at random around this particular curve and I am sure that these are representative. Others would be very similar, only in a greater or lesser degree, and we will get some idea of the actual degree from what we have here.

Mr. Simpson: I would like to have that chart marked Plaintiff's Exhibit 9, and I have a photostat of that
 51 same chart and I would like to have that marked Plaintiff's Exhibit 9-A, and I offer them in evidence.

(The chart referred to was received in evidence and marked "Plaintiff's Exhibit No. 9." The photostat thereof was received in evidence and marked "Plaintiff's Exhibit No. 9-A.")

A. In case alternating current is used, we will assume (and it has been assumed on this chart) that that alternating current has been applied for an appreciable length of time. There are conditions that take place when an alternating current is first applied which are not at all conducive to consistent results in magnetization, so for that reason we are assuming here that our current has gone through enough complete cycle variations that we have reached a stable state. In other words, we have traversed this path a number of times, the outside envelope on this hysteresis curve. In this particular diagram, we have indicated our horizontal axis as field. This, before, we considered as magnetizing force or current, and the top was also indicated in the blackboard drawing as flux.

Above the hysteresis loop is plotted an alternating current wave. That is a very close approximation to a sine wave which power companies attempt to maintain on their power systems, so it is typical of current in the majority of cases.

According to this diagram, we start at A, which is zero point just before current has started to increase in
 52 the positive direction. That, then, will mean that since we are in a cyclical condition, we are starting at this point down here. This point here is labeled A, but it actually should be down here if we assume a cyclical condition. If we had had previous cycles, we would be going around this way. If we start at A, we would start with this original curve, or virgin curve, as it is spoken of sometimes, the same as described over here. So the first rise from zero to maximum would be A-B and would bring our magnetization up along the virgin curve.

If we interrupt that current at that point, that interruption of current merely constitutes a reduction in that current to zero, so our magnetization in the piece will follow back through C to D, resulting in this much magnetization.

If we continue that current on down——

Q 40. (Interposing): Let me interrupt you a minute, Mr. Clarke. When you say "this much magnetization," will you indicate the letters which represent the amount you are referring to? A. Yes, the magnetization will be represented by the distance A-D on this vertical flux axis.

Q. 41. That is the actual amount of magnetism left in the piece? A. That is the actual amount of magnetism
 53 in the piece. That same thing will be true if we assume that we break the current at C on this chart. C would have brought us back to this point on the curve. Causing a complete removal of magnetizing force at this point will bring us back again to D and the actual magnetization will amount to that represented by the distance A-D.

Continuing now to E, we pass through D and our current is reversed; we have started to build up in an opposite direction. However, up to that time the field in the piece has not actually reversed and there is more or less—well, we can describe it as a sort of tendency in the magnetization of the material itself to return to previous condition. I think that will explain it about as well as anything.

Here we have renewed our magnetizing force at E, and rather than remain at that point, actually our field builds back up to a little higher volume and actually in reverse direction to where our magnetizing force is at the same time.

Continuing to F, then we are on the very steep portion of that and a break at F actually has carried us across to where magnetization is in the same direction as the current, in the opposite direction to the original case, but a break at this point will result in material dropping off to some point such as that which is indicated there. It is not actually lettered in the diagram.

54 Q. 42. Do you wish to put a letter on it, Mr. Clarke, so you can refer to it? A. Yes, I will letter that K.

(The witness marked the point indicated on the chart with a letter K.)

A. If we continue on through F and continue to G, we have built up again to another peak in the opposite direction and we have the same condition that we had up at B, so an interruption here will result in the magnetization curve dropping back to H. In other words, we have now a field left in the piece which is represented by A-H. That is, the distance A-H is the same as the distance A-B, which means that regardless of what polarity, which peak of magnetizing cycle we have used, we will get the same intensity of magnetization in the part.

Continuing on, then, from H which was the zero, we build on up to I.

Q. 43. Let me interrupt. Will you explain what would happen if you should interrupt at H? A. If we interrupt at H, H actually represents a zero current point and if we

actually interrupted at that place, we are in the condition where there is no current flowing, there is no magnetizing force being applied, but there is a field in the piece which at that instance is equivalent to any field which you
 55 would get by any other position chosen at random up along here, so you will get maximum magnetization if you interrupt at H.

Mr. Simpson: Let the record show that the witness was pointing to the position of the curve between H and G.

A. That is the condition that will obtain.

Q. 44. How much magnetism is there left in the piece if you break at H? A. If you break at H, the amount of magnetism is indicated by the distance A-H, or A-D if it had been at the other side of the curve. D is the point that corresponds to H, so the same condition will hold there.

The other points on the curve are very similar to those discussed already. J brings it back down farther.

The Court: This is a very interesting lecture, if we may so express it, on magnetism, but it seems to be somewhat removed from the issues before the Court. I have allowed this witness over half an hour for a lecture on magnetism. I think we had better get something nearer the issue in this case. It is admitted that magnetism works in the way he has been telling us and there is no patent asked for here on the cause of magnetism, is there? The question is about the use of magnetism, and the use of these two means of stopping it, and so on, so I think maybe we might be able to brief it up somewhat.

Mr. Simpson: We will try to hurry along through
 56 this portion.

The Court: It isn't a matter of hurrying, but we don't want to go into the whole subject of magnetism because that isn't really at issue.

Mr. Simpson: The reason we are attempting to show this, Your Honor, is that we believe that certain misunderstandings of certain fundamental principles led the Board of Appeals astray in rendering the decision they did, and

we feel that certain of these fundamentals are essential to a proper understanding of the subject.

The Court: You might brief them up somewhat. You have given on the blackboard just about the same thing you have given in this Exhibit 9, which is a duplication. Let's try to get along with the case a little more rapidly if we can.

Mr. Simpson: We would like to refer to one more chart in connection with this general problem—it will take only a few minutes to do it—to show what happens when you have a damped break on the wave. That is very important in the consideration of the difference between the prior art references and the disclosure of the present application.

Q. 45. Mr. Clarke, I show you this chart which is labeled, "Chart Illustrating Demagnetizing Effect of a Damped Break in Alternating Current Energizing Wave,"
57 and ask if you recognize it. A. I recognize it.

Q. 46. Did you have that chart made under your direction and supervision? A. I did, sir.

Q. 47. Will you tell the Court very briefly what happens when you get a damped break in the end of the alternating current wave just before it is completely interrupted? A. This chart shows another magnetization curve from alternating current. In this particular case we have a cycle and a half, in other words three half cycles which are of normal amplitude, and then the amplitude starts to drop off. There has been a reduction in actual strength of current at the end. We start here with a cyclical condition such as we had before where our magnetizing force is traversing the outside. That carries through all the way, which I will not explain again, to B'—from A through to B' we have gone through this curve down to D and back up to B'.

Returning to C' brings us around another cycle and back to a zero magnetizing force.

If successive half cycles actually go to lower peak values, we no longer traverse this curve. Actually we have an infinite number of curves, making up a whole family, that can represent any one given magnetizing material, and we are

gradually in this case going from one of these curves
 58 to another. All will have their peaks or times ascen-
 dant on this virgin curve and we are gradually going
 through a staggering action back and forth from one side
 to another of that virgin curve. Coming down to C, which
 is our first peak to reduced amplitude, brings us this far;
 coming up to F brings us back to a new zero which corre-
 sponds to zero with E as its peak. Continuing with G as a
 peak brings us up to this point which is approximately on
 the virgin curve and corresponds to a peak on the curve
 with F as a maximum. Returning to zero gives us what
 would be obtained as a field in the piece after we had gone
 to a peak of G and returned to zero.

The strength in this case of the magnetic field left in the
 piece is indicated by the distance from this center line up to
 H. That is the first time on the positive side. It is actually
 the second half cycle, since we went through one of these
 zeros up here, but in this particular case now, that value at
 H corresponds to this peak G which is somewhat less than
 half of the peak value before, but you can see that it is much
 farther down on this line here, actually showing the field in
 the piece.

Continuing on, we go to another cycle. The fourth half
 cycle will bring us to K and finally when we reduce to L or to
 zero, we will have a field left in that piece that is just a very
 small percentage of the total. In that particular case, we
 have probably represented a reduction of, say, five to
 59 one, but the actual reduction of the field in the piece
 is very much greater than that.

Q. 48. Would you say, then, that a damped break at the
 end of a wave would indicate conclusively that only a very
 small amount of magnetism would mean in the piece? A.
 Yes, it will.

Q. 49. And that is shown by this lower curve here? A. Ac-
 tually, the value left in the piece would be represented by
 the distance from the origin to L as compared with the dis-
 tance from the origin up to C-C, which is several times as
 much, eight or ten.

Q. 50. Would you say that the important consideration in determining how much magnetism was left in the piece is to determine what the amplitude of the last half cycle of current is before it is completely interrupted? A. Yes, that is the entire and the sole determining factor because each in reversal has removed the field in the piece. It was due to the half cycle immediately before it, so it is the last half cycle that is responsible for the field left in the piece.

Q. 51. You have used the term here, damped break in the a.c. wave. Would you explain in two or three words what you mean by damped break? A. A damped break is represented by this chart here, where there is actually a
60 reduction in amplitude between successive half cycles.

Mr. Simpson: I offer this chart as Plaintiff's Exhibit 10, and a photostatic copy of it as Plaintiff's Exhibit 10-A.

(The chart entitled, "Chart Illustrating Demagnetizing Effect of a Damped Break in Alternating Current Energizing Wave" was received in evidence and marked "Plaintiff's Exhibit No. 10." A photostatic copy thereof was received in evidence and marked "Plaintiff's Exhibit No. 10-A.")

Q. 52. Have you examined the certified copy of the Foster B. Doane application, Serial No. 269,644, Plaintiff's Exhibit 1? A. I have, sir.

Q. 53. Will you briefly summarize the type of magnetic testing means which is described in this application? A. I have with me the office file copy of correspondence on this. May I use that to refer to, to refresh my memory on all of these patents?

The Court: Yes.

Q. 54. I believe, Mr. Clarke, you had a chart prepared, putting on it figures 3 and 6 of that application for the Court's convenience, is that correct? A. That is correct.

Q. 55. And that chart was made under your direc-
61 tion and supervision? A. It was.

Q. 56. Will you describe to the Court briefly the nature of the two types of circuits which are illustrated in the

Doane application? A. The Doane patent application makes use of or suggests two types of equipment which are satisfactory for a break which will produce the results intended from the text of that patent. The first of these is a mercury switch which is nothing more than a glass or insulating enclosure containing sealed-in electrodes and a quantity of liquid mercury. The second, then, is a type of breaker which is referred to as a de-ion breaker commercially and consists of metallic contacts which make and break the circuit. These metallic contacts then are suitably situated in an arc damping chamber of rather peculiar characteristics which determine the nature of the arc and the nature of the break that takes place in that.

Q. 57. Would you say that these two circuits are each arranged to interrupt the current at substantially the zero point of the current cycle? A. Either of those will do that.

Mr. Simpson: I wish to offer this chart as Plaintiff's Exhibit 11, and here is a photostat of it for the Court's convenience which we will offer as 11-A.

(The chart referred to was received in evidence and marked "Plaintiff's Exhibit No. 11." A photostatic copy thereof was received in evidence and marked "Plaintiff's Exhibit No. 11-A.")

Q. 58. Have you examined a copy of the British patent to Hauser, No. 379,337? A. I have.

Q. 59. Will you describe briefly to the Court the apparatus which is described in the Hauser patent. A. There is also a chart that I would like to use on that.

Q. 60. Did you cause that chart to be made under your direction and supervision as a copy of the drawing of the British patent to Hauser? A. I did.

Mr. Simpson: Might that chart be marked Plaintiff's Exhibit 12, and the photostatic copy of it, 12-A.

Proceed, Mr. Clarke in describing it.

(The chart reproducing the drawing of the Hauser patent was received in evidence and marked "Plaintiff's Exhibit No. 12." The photostatic copy thereof was received in evidence and marked "Plaintiff's Exhibit No. 12-A.")

A. In the Hauser patent, no provision is made at all for breaking the electric circuit. The whole device applies merely to a piece of equipment which will accomplish
 63 a satisfactory break, and the break is described as satisfactory. It actually consists of what is generally termed a polarized relay which is connected in parallel with the magnetizing circuit. The circuit that is used in connection with the Hauser device consists of a magnetizing coil, and if we want to trace the actual current paths, we will find that one side of the magnetizing circuit goes directly to an electric feed line of some sort. The other side of that magnetizing circuit goes to one side of a contact in the Hauser device and through a contact which can be opened to complete the circuit.

Q. 61. By contact, do you refer to the point on the chart marked main line switch? A. That is the contact marked main line switch on this chart. This is not the way that that is marked in Hauser. In fact, I believe that it isn't marked at all in Hauser, but that was added for convenience.

Q. 62. You marked it main line switch for the convenience of the Court? A. And for clarity.

Q. 63. It is referred to as 11 and 12 in the British patent. A. It is referred to mainly as a contact arm or pair of contacts, but it does actually constitute a switch to open the main line to the magnetizing coil, and that is considered to be a little bit more clear in this case.

64 In parallel with the magnetizing coil we have another circuit which consists of this choke coil and a relay coil. The shunt circuit is from the line through the choke coil to the relay coil and then back through an actuating switch which we have chosen to label here a relay switch for clarity.

The action is described by him as being this, that immediately above the core of the relay coil is the pole of a permanent magnet. In the gap between this pole is an armature which is attached to a rather long lever arm which we have indicated here as trip lever for clarity, and as a continua-

tion of this trip lever arm there is an insulating block that is fastened rigidly to the upper contact arm of this main line switch. In other words, the upper half of this main line switch, the insulating piece, the trip lever and this armature are all rigidly connected and pivoted at this point. The trip lever is rigged up by a rig there which is adjustable.

The action is supposedly this, that some main line switch or some switch preceding this circuit is supposedly closed, admitting current to a magnetizing curve, and after this has flown for any length of time desired, this relay switch is closed. Since this permanent magnet is in place here and there is a field set up across there, the field, due to this relay coil, will either aid or oppose that and will cause it to open at a pre-chosen polarity on the magnetized cycle.

65 The actual polarity at which it is intended to open is determined by the polarity of this magnet here.

There are two types of polarity that I have referred to: one is magnetic polarity and the other is polarity of electric current, but I don't believe that they will be confused.

Q. 64. Will the main line switch open instantaneously as the relay switch is closed? A. I wouldn't say that it would open instantaneously at all. Of course, there is nothing said as to dimensions. If we go by the approximate dimensions of the drawing that is given in the patent disclosure, we have a considerable mass of material to move through a rather long lever arm, and I would hardly say that it is an instantaneous motion at all, or even a fairly rapid one.

Q. 65. What would be your opinion as an expert with regard to the statement which Hauser makes in the specification of his patent to the effect that a polarized relay will effect the interruption of a current wave at the crest of the current cycle? A. As I said in my last statement, there is quite a mass of material to move there, quite a bit of inertia, and a number of other things. It might open at the crest, but I don't think it would be consistent at all.

Q. 66. You mean it wouldn't consistently open at the crest of the current wave, due to the mass of material and

66 the mechanical system that is involved? A. Out of a number of trials, it would be quite hit and miss. Sometimes you would get them at one point and sometimes at the other. But as for a consistent opening at the crest, I don't believe that it could be adjusted and kept in adjustment to where it would do it infallibly.

Q. 67. Would you as an expert say that it is possible consistently and uniformly to interrupt the current wave in Hauser at any definite, pre-selected point? A. I don't think that that would be possible, for the same reasons that it wouldn't be possible to interrupt at the crest. There are certain features about the device which inherently will make it either erratic or at least changeable over a short period of time, and I don't think that you can determine very closely any particular point and hold to it.

Q. 68. What would be the situation that would prevail at the main line switch if that switch were opened at the crest of the current wave, as Hauser suggests? A. I don't quite understand your question.

Q. 69. Would you as an expert say that the opening of the main line switch at the crest of the current wave will draw a large arc? A. Yes, undoubtedly it would; if it were open at the crest of the current wave there would be a considerable arc at opening.

67 Q. 70. What would be the effect of that arc? A. The arc, due to the contour of the contacts, and all, would very probably exhibit a resistance characteristic which was quite variable. It would no doubt start at a low value and continue to increase as long as that arc were maintained, until it finally blew out. We would have considerably higher resistance, and as a result, a considerable reduction in line current or magnetizing current.

Q. 71. By your statement, then, do you mean that this considerable increase in resistance in the circuit of the magnetizing coil would cause a decrease in the amplitude of the alternating current wave? A. In the actual circuits that it is absolutely necessary to use for magnetic testing in gen-

eral, the resistance of these arcs can play a big part, and if the resistance goes up, magnetization can vary greatly. In this case, that was why I mentioned the resistance of the arc, because it could get to be a determining factor in the final magnetization.

Q. 72. Aside from the polarized effect that you have in the Hauser patent, would you say that the nature of the line interrupting mechanism itself was equivalent to a knife switch? A. It merely consists of two metal contact surfaces that are separated, which is the condition that obtains when a knife switch is opened. The actual condition at breaking contact on a knife switch is nothing more
68 than separation of two metal contacts.

Q. 73. Do you find any suggestion in the Hauser patent that the current wave will always be interrupted at the zero point of the current cycle? A. No, not in the Hauser patent.

Q. 74. I call your attention to a statement which the Patent Office one time referred to in the Hauser patent, which appears on page 1, beginning with line 28, which states, "But even interruption at the netural point as already proposed for the primary circuit of a transformer fed with alternating current, which could also be used as a magnetizing apparatus, merely insures the interruption at a moment at which the field of the secondary winding possesses its maximum strength." What does that statement mean to you? A. I really don't know. It isn't too clear. He says, "Even interruption at a neutral point." I am not entirely clear as to what he is referring to as a neutral point. A neutral point in what?

Q. 75. You will notice that this statement refers to interrupting the primary circuit of the transformer in which the magnetizing circuit is connected on the secondary. Is it possible to have a different condition prevailing in the secondary circuit from that prevailing in the primary circuit with respect to the particular point where you are on the current cycle at the time that the current is inter-

69 rupted in the primary circuit? A. The primary and the secondary in any transformer such as he is referring to here are on the same magnetic circuit and there can only be one magnetic condition exist at one time. If it were a neutral field as far as the primary is concerned, it would be a neutral field as far as the secondary is concerned, depending on how neutral would be interpreted. At the same time, if maximum refers to field strength in the core of that transformer, the core is common to both so it is going to be a maximum in the primary and that will be due to a maximum current, so I don't believe that his teaching is entirely clear on that at all.

Q. 76. Is the current in the secondary of a transformer in phase with the current in the primary of the transformer?

A. In general it can be considered as actually 180 degrees out of phase, which means that values are approximately the same at any instant, or bear a fixed relation to each other at any one instant, but were actually opposite in direction, so it could be taken as meaning that they are in phase so far as intensity is concerned and directly opposite so far as the actual direction is concerned.

Q. 77. You would state, then, that in your opinion as an expert, this statement that I have referred to in the Hauser patent is difficult to reconcile and understand? A. I think that it is, yes.

70 Q. 78. Have you examined the copy of the French patent to Van Meyl, No. 593,863? A. Yes, I have.

Mr. Simpson: I understand that Mr. Whitehead has had a translation of the French patent prepared. I have one here that we independently had prepared and executed. Mr. Whitehead's translation is perfectly acceptable to me and I understand that he will introduce it as an exhibit in his case.

Mr. Whitehead: There is very little difference; there is some difference in the wording of the two translations, as there sometimes is. It is the same meaning.

Mr. Simpson: I won't introduce my copy and clutter up the record uselessly.

The Court: He is going to introduce as an exhibit, which will be Defendant's Exhibit No. 1, all the different patents and the Examiner's statement and the decision of the Board of Appeals, and the decision of the Board of Appeals on the request for reconsideration. They will be filed as Defendant's Exhibit No. 1, including the translation of the French patent and the drawing.

Q. 78. Mr. Clarke, you had a chart prepared which is a copy of the figure in the French patent to Van Meyl? A. I did.

Q. 79. Was it prepared under your direction and
71 supervision? A. It was.

Mr. Simpson: I offer this chart as Plaintiff's Exhibit 13, and a photostatic copy as 13-A.

(The chart referred to was received in evidence and marked "Plaintiff's Exhibit No. 13." The photostatic copy thereof was received in evidence and marked "Plaintiff's Exhibit No. 13-A.")

Q. 80. Have you made a study of this French patent and determined the nature of the disclosure therein? A. I have.

Q. 81. You had a translation of the French patent? A. I had a copy of the translation.

Q. 82. That was the translation which was made by Mr. Ranis? A. That is right.

Q. 83. Will you describe what you find in the French patent, No. 593,863? A. This piece of apparatus is described by Van Meyl as being for the purpose of magnetizing permanently magnetizable materials, preferably pieces in the shape of a horseshoe, and the like. Magnetization is accomplished by means of a coil, and the article is placed around the coil with a yoke to close the circuit and current is interrupted to produce a satisfactory magnetization by
72 means of a fuse or, as he describes it, some suitable magnetic contactor that can be used in place of a fuse.

In this drawing, which is a copy of the drawing accompanying the patent, the coil is annular or ring-shape and is enclosed inside a box of wood or some other suitable mate-

rial. One side of the box is cut away so that an article to be magnetized can be set down in the position that it straddles the coil, and an iron yoke or piece of material closing the magnetic circuit is inserted through the center. This projection in the center of the box is indicated as being a junction box for use in connection to an outside current source, and in that junction box is contained the fuse which is responsible for interrupting the current. This switch is merely an operating switch when the part is placed in the box to be magnetized; this switch is used to close the circuit, after which the fuse or the interrupter opens to complete magnetization.

Q. 84. Is there any mention in the French patent that this magnetizing arrangement here may be used for magnetic test purposes or inspection purposes in flaw-detection apparatus? A. No.

Q. 85. Do you find any such suggestion in the British patent to Hauser? A. No, there is no mention made of test purposes at all.

73 Q. 87. Have you examined a copy of the Wilson patent, No. 533,938? A. I have.

Q. 88. Will you refer to a copy of that patent and describe very briefly the nature of the disclosure in that patent? A. The Wilson patent is one which applies to a signaling device for railroads. It consists merely of a set of permanent magnets which actuate through a suitable yoke mechanism a swinging light or signal of some sort. It happens that in this particular drawing, or in this patent, he has used mercury tubes for breaking this current.

Q. 89. You don't find any suggestion in that patent, then, that a mercury switch is used in a magnetizing circuit? A. No.

Q. 90. There is no suggestion at all? A. No, there isn't. There are some actuating magnets in this but the switch merely serves the true purpose of a switch and there is nothing in regard to permanent magnetization; and the fact is, if permanent magnetization were accomplished the arma-

ture would go down and it would keep your signal at one side all the time.

Q. 91. And then it would be an inoperative circuit? A. That is right.

Q. 92. Will you turn to the Hewitt patent, No. 799,052 and refer very briefly to the general nature of the disclosure in that patent? A. The Hewitt patent is merely
74 a device for opening or closing a circuit. It is strictly, as it is titled, a circuit controller. It opens a line or closes a line, and is a rather simple means of doing that, with no moving parts. That is the primary object here, to have no moving parts or no wearing parts in the Hewitt patent.

Q. 93. You don't find any suggestion in the Hewitt patent that the circuit controller there may be used in a magnetizing circuit? A. No.

Q. 94. Turn to the Kraus patent, No. 1,046,086 and tell the Court briefly what this disclosure relates to. A. Kraus is another device which might be termed a circuit controller or a line controller. This is another instance where there has been an attempt to cut down on mechanical moving parts. Actually, in the case of Kraus the parts aren't eliminated entirely as in Cooper, but they are cut down in size very considerable. It is an overload device, that is what it is, and the object in cutting down the weight of mechanical parts is that much higher speed can be obtained.

Q. 95. Did you find any suggestion in the Kraus patent that the circuit interrupter therein may be used in a magnetizing circuit? A. No.

75 Q. 96. Will you turn to the Slepian patent, No. 1,932,090, and tell the Court briefly what is described in that patent? A. In that patent is described a circuit breaking device which is intended for general circuit breaking use, and the device that is described consists of a pair of metallic contacts which make and break the electrical circuit.

Q. 97. Do you find any suggestion in the Slepian patent that the circuit breaker described therein may be used in a

magnetizing circuit? A. There is nothing that refers to a magnetizing circuit.

Mr. Simpson: I might make a statement at this time, Your Honor, in connection with the De Forest patent, No. 2,110,759. I understand that the Patent Office does not rely on that patent in connection with the basic claim that is involved in this case, nor in connection with the claim which includes the mercury switch, for the reason that it has a later filing date than the filing date of the patent application on which the present application is based. The Doane application described a mercury switch, and the only use that the Patent Office makes of the De Forest patent is in connection with the single claim that relates to a de-ion breaker.

The Court: Very well.

76 Mr. Whitehead: That is so stated in the record. There is a general statement there.

The Court: Does that complete your direct examination of this witness?

Mr. Simpson: No, it does not. We have a number of laboratory tests and oscillograph records to introduce.

The Court: We will take a recess until 1:30.

(Whereupon, at 12:30 p.m., a recess was taken until 1:30 of the same day.)

77 After Recess.

The Court: Are you ready to proceed?

Q. 98. Mr. Clarke, did you cause a series of tests to be made to determine the relative effect on permanent magnetism of the piece by opening an alternating current magnetizing circuit by a number of circuit-interrupting devices?

A. I did.

Q. 99. Will you describe the test apparatus which you used? A. The test apparatus which was used in these tests consisted of a magnetizing circuit consisting of suitable transformer equipment for converting alternating voltages to proper values to provide the magnetizing currents we

wanted and for feeding magnetizing equipment. The magnetizing equipment itself consisted of a coil which was to accomplish actual magnetization, and in series with this coil were to be placed various types of breaking equipment to accomplish breaks in a number of different manners or by a number of different means, rather.

Q. 100. I believe, Mr. Clarke, that you caused a chart to be made to indicate the equivalent circuit diagrams of the test circuit as well as of the circuit in the Doane application, the circuit of the French patent of Van Meyl, and the British patent of Hauser. A. I did.

78 Q. 101. Was this chart made under your direction and supervision? A. It was.

Mr. Simpson: I ask that that chart be marked Plaintiff's Exhibit 14, and a photostatic copy 14-A, and I offer these in evidence.

(The chart referred to was received in evidence and marked "Plaintiff's Exhibit No. 14." The photostatic copy thereof was received in evidence and marked "Plaintiff's Exhibit No. 14-A.")

Q. 102. Mr. Clarke, will you refer to that chart and point out the various elements of the test circuit? A. The first diagram, which has been labeled Hauser, is the equivalent circuit of the Hauser patent. In this particular arrangement here which has been drawn in this manner to make the entire circuit more clear, more understandable, the coil is indicated and labeled as such. This piece that is marked "article" in the diagram is the part that was actually to be magnetized. The entire circuit is fed from this end where the two lines with the arrows on them indicate incoming feed wires to the piece of test apparatus.

This device indicated in here, including all of the remainder of the circuit, is the equivalent of the Hauser device.

79 Q. 103. By that you mean it is equivalent to the polarized relay described by Hauser? A. Yes, and the markings on this chart were the markings on the chart which was presented earlier showing the actual dis-

position of parts. This is the relay switch which was indicated at the top left-hand corner of his diagram. This is the relay coil which surrounds the opening immediately under the U-shape permanent magnet. This is the choke coil which is shown as a ring-shaped device lying flat on the base of the device; and this is the switch with its actuating arm which in its entirety had two or three different labels to make it up: trip lever, main line switch and insulation.

Q. 104. When the relay switch is closed here, does that open the main switch by pulling up on this movable switch arm? A. It does. Closing this relay switch causes current to flow through both the choke coil and the relay, draws this cord and it opens the switch arm.

Q. 105. Now refer to the Van Meyl circuit. A. The Van Meyl patent describes merely a coil with an interrupter in the form of a fuse in series with it, and an actuating switch in series with the whole. The current is fed here. Flow of current is in this direction. The fuse is responsible for interrupting the circuit. The coil is responsible for the magnetization, and this is the article to be magnetized.

Q. 106. And now refer to the circuit diagram of 80 Doane. A. In the Doane application, the de-ion contactor is used for the purpose of interrupting this current and the requirement is merely that it will be placed in series with the magnetizing device so that it will close and open that circuit. This is the magnetizing coil for magnetizing the part which is here marked "article," and the part marked "de-ion switch" is the actual contacting device that makes and breaks the circuit.

Q. 107. Will you now refer to the test circuit? A. That was used to simulate all of the conditions shown above. In the first place, starting from the left we have our incoming feed line supplying current to the setup as a whole. Next in line we have a resistor. It is marked "resistance" in this particular case. Either is correct. The actual marking is "Resistance to oscilloscope." The purpose of that resistor's being inserted in the line is that in this particular setup

we want to make oscillographic records. In other words, we want to take a picture of the current that was responsible for the magnetization, and in order to do that, we used a cathode ray oscilloscope which is a voltage-operating device. By inserting a small value of non-inductive resistance in series in that circuit, a voltage can be fixed off across that circuit or across the resistance which is at all times proportional to the current flowing in the circuit, and it was the purpose of actually obtaining reading and graphic
81 records that this resistance was inserted here.

Immediately after that in the circuit was a knife switch that was an ordinary hand-operated knife switch of the single pole variety.

Next after that, in series with both of these was the contacting element in a de-ion circuit breaker, and associated with that contact element in the de-ion circuit breaker some other apparatus is necessary here. For instance, that is a magnetic breaker. It requires that current be fed to an actuating coil which actually closes these contacts. So in order to get control for that coil, the breaker coil, as it is marked here, was connected to one side of the incoming line and then connected to the other side of the line by means of another switch which is labeled "breaker switch" in the diagram.

The coil here that is used for magnetization corresponds to the coils that are indicated above, and the article again is the piece of material which was to be magnetized.

Q. 108. When you were making tests with the de-ion circuit breaker, what condition was the knife switch left it?

A. In making tests with the de-ion circuit breaker, the knife switch would remain permanently closed. It then became a part of the permanent circuit and had nothing to do
82 with the circuit characteristics whatever.

Q. 109. And when you were making tests with the knife switch, what condition was the de-ion circuit breaker in? A. The de-ion circuit breaker in that case also was left closed, just as the knife switch was in the first instance. The

de-ion breaker then became a continually closed part of the magnetizing circuit.

Q. 110. Did you cause any tests to be made in which a mercury switch was used? A. I did.

Q. 111. How was that done? A. In that case, the mercury switch was substituted for the knife switch, the knife switch being left open and the mercury switch shunted across the knife switch.

Q. 112. What condition was the de-ion circuit breaker in when the tests were made with the mercury switch? A. The de-ion switch then, of course, had to remain closed.

Q. 113. Did you make any tests in which the fuse element was used to interrupt the circuit? A. Tests with fuses as an interrupting means were made and they were connected in exactly the same manner as the mercury switch, shunted across the knife switch terminals while the knife switch blade was left in the open position.

Q. 114. What was the general order of magnitude
83 of the voltage and current which you used in conducting these tests? A. On all these tests, the voltage was supplied at approximately 208 to 220 volts, depending on the line voltage at a particular location, and the current was in the neighborhood of 100 amperes through the coil.

Q. 115. Are these values of voltage and amperage comparable to those used in actual commercial equipment? A. Yes, the coil actually used was a commercial coil. It was used for convenience as well as better to give a picture of commercial equipment.

Q. 116. Did you have someone assist you in making these tests? A. I did.

Q. 117. Who was it? A. Mr. Grant Coon.

Q. 118. Is he connected with Magnaflux Corporation? A. He is connected with the Magnaflux Corporation, yes.

Q. 119. I now hand you a paper, and ask that it be marked Plaintiff's Exhibit 15 for identification, and ask you if you can identify the paper. A. I can identify it, yes. I recognize it.

(The paper identified by the witness was marked "Plaintiff's Exhibit No. 15 for Identification." A photostatic copy thereof was marked "Plaintiff's Exhibit No. 84 15-A for Identification.")

Q. 120. Will you tell the Court what Plaintiff's Exhibit 15 for Identification represents? A. This exhibit is an actual transfer of magnetic particles which were taken, or indications as they are generally spoken of—indications of defects by means of magnetic particles, which were taken from the sample which has already been entered as an exhibit, after being magnetized by different means.

Q. 121. I believe you were referring to Plaintiff's Exhibit 7 when you were referring to the actual piece.

A. Yes, the steel sample with the defects on it that was introduced.

Q. 122. Will you explain how the paramagnetic particles which had been sprinkled on that piece are transferred in the manner in which they appear on the paper in your hand?

A. If I may have the sample again, I can show you just how those are made. (Demonstrating with Exhibit No. 7) The indications which are on here from the powder that was placed on there earlier are mostly still on there. I have put a little more powder on there to bring them out a little heavier, and by tapping I have removed the excess so that the indications of the defects are there in the same manner that they were before.

To make a permanent record of those indications
85 can easily be done by placing a membranous material of some sort with a tacky surface over that. This that I have is a roll of ordinary transparent cellulose tape or Scotch tape as it is called sometimes, and by placing that Scotch tape on this specimen having the defects in it and the powder indications on it, with the tacky side next to the indicating material, I can transfer those indications in the form of a permanent record. I can place the tape on there and rub it into firm contact, and then after it has been rubbed into firm contact, the tape can be removed

merely by pulling it off the surface and the powder deposits which have accumulated over the defects will come right off with it.

In case a permanent record of that is wanted to be made, we still have that tacky surface exposed and it isn't in a form that could be filed or handled very advantageously, so that can be mounted on a piece of plain paper of a suitable color to form a contrast with the material itself, and a suitable record is then recorded of that material.

Mr. Simpson: I offer this in evidence as Plaintiff's Exhibit 15-B as illustrative of the witness' testimony.

(The record of the witness' demonstration was received in evidence and marked "Plaintiff's Exhibit No. 15-B.")

Q. 123. Now will you refer to that paper which is
86 marked "Plaintiff's Exhibit 15 for Identification" and explain to the Court what the writings and figures are to the left of the Scotch tape? A. There are two columns to the left of the Scotch tape. The first column is headed "Switch"; the second column is headed "Compass." In the column headed "Switch" is listed the particular type of breaking mechanism that was used for magnetization when each of the transfers immediately opposite that legend was recorded. There are four recordings on this particular sheet that were made by magnetizing the piece, using a knife switch to interrupt the current, and there are two on here that were made by using a de-ion switch to interrupt the current.

Q. 124. What do the readings under the column labeled "compass" indicate? A. The readings under the column indicate or give a relative indication of the pole strength of the magnet which is made from a piece after it has been magnetized, the actual pole strength set up in the piece.

Q. 125. By pole strength, you mean the amount of magnetism that is in the piece? A. The amount of magnetism that is in the piece, yes, the actual strength of the field that has been set up in it. These terms are actually readings of

distance in one particular magnetizing setup where a compass is placed in a fixed position, and a part is brought up toward that compass either from the east or the west of the compass. Normally when there is no magnetized material around, it will point in a north or south position, but when a magnetized piece is brought up to the side, there will be a compass deflection, and these readings are the number of centimeters away from that compass that the part needed to be placed to effect a fixed number of degrees' deflection on the compass needle. The larger the reading in this particular case, the greater the magnetization. It isn't linear, though; it is something less than the square of the distance.

Q. 216. Is this arrangement for measuring the relative amount of magnetism left in the piece a conventional way of measuring relative magnetism? A. It is a conventional method. The equipment is spoken of as a magnetometer, or it is spoken of as being the magnetometric method of measuring pole strength.

Q. 127. Will you again refer to that test record sheet, Plaintiff's Exhibit 15 for Identification, and tell the court what you found by the series of readings which were made and which were reproduced on that sheet? A. On this sheet, out of the six tests that were made, there are four which were made with a knife switch for breaking the circuit, and two with the de-ion. Of the four which were made with the knife switch, three show no indications at all. I would like to correct that. There is a very faint indication on the last one labeled "knife switch." There are two which show no indications at all, one which shows a very faint indication, and a fourth which gives an indication which might very well be considered a perfectly normal and satisfactory one.

Q. 128. What do you find in connection with the de-ion switch? A. In the two that were made with the de-ion switch, the test is entirely satisfactory. The two correspond very closely.

Q. 129. Were all of these tests made on the same test piece? A. They were all made on the same test piece, yes, sir.

Q. 130. Was it a test piece which was known to have a defect in it? A. It was. It had the defects that are shown in this transfer. The test piece is the one which we are using here as an exhibit.

Q. 131. And you find that two tests, in connection with the knife switch, failed to indicate the presence of defects in the piece, although the defects were actually there? A. That is right.

Q. 132. I now hand you another sheet of paper that
89 has a number of pieces of Scotch tape affixed thereto, and ask if you can identify it? A. I can. I recognize it.

Q. 133. What is it? A. It is another series of tests that were conducted by Mr. Grant Coon at my direction, to determine the characteristics of magnetization accomplished when a mercury switch was used to interrupt the magnetizing circuit.

Q. 134. Whose signature is that on the paper? A. Grant W. Coon's.

Mr. Simpson: I ask that this be marked Plaintiff's Exhibit 16 for Identification, and I have a photograph of this which I ask be marked 16-A for Identification.

(The paper with the attached records of tests was marked "Plaintiff's Exhibit No. 16 for Identification." The photograph thereof was marked "Plaintiff's Exhibit No. 16-A for Identification.")

Q. 135. Were these readings all made with one type of switch? A. They were.

Q. 136. What type of switch was used? A. A mercury switch was used in this case.

Q. 137. Did the mercury switch always give an indication of the presence of flaws or defects in the piece?
90 A. Yes.

Q. 138. What is the column of figures to the left of the Scotch tape? A. The column of figures is headed, "Compass reading in centimeters for 50 degree deflection." The figures given under this are the distances from the center of the compass to the end of the piece which was being measured. It was the same magnetometer test that was described on the exhibit immediately preceding this.

Q. 139. I hand you another piece of paper, and I ask that it be marked as Plaintiff's 17 for Identification; and I have a photograph of this paper and I ask that it be marked Plaintiff's Exhibit 17-A for Identification.

(The paper with attached records of tests was marked "Plaintiff's Exhibit No. 17 for Identification." A photograph thereof was marked "Plaintiff's Exhibit No. 17-A for Identification.")

Q. 139. (continuing) I now hand you the paper which has been marked Plaintiff's Exhibit 17 for Identification and ask you if you can identify it. A. I can. I recognize the paper.

Q. 140. What is the paper? A. It is a series of tests that were conducted in the same manner as Exhibits 15 and 16, excepting that in this case the de-ion breaker was used in place of the mercury switch and the knife switch
91 that were used in the previous two.

Q. 141. Was there always an indication of the presence of the defects in the test piece? A. The indication was always present.

Q. 142. Whose signature is that on the bottom of the paper? A. It is signed by Grant Coon who actually did the work.

Q. 143. What are these figures to the left of the Scotch tape? A. Those are magnetometer readings again which indicate pole strength.

Q. 144. I now hand you another piece of paper having a number of pieces of Scotch tape affixed thereto and certain writings thereon, and I ask that it be marked as Plaintiff's

Exhibit 18 for Identification. I have a photograph of this paper and I ask that it be marked Plaintiff's Exhibit 18-A for Identification.

(The paper with attached records of tests was marked "Plaintiff's Exhibit No. 18 for Identification." The photograph thereof was marked "Plaintiff's Exhibit No. 18-A for Identification.")

Q. 144. (continuing) I hand you now the paper which has been marked Plaintiff's Exhibit 18 for Identification and ask you if you can identify it. A. I recognize this as
92 being another series of tests made in the same manner as those immediately preceding.

Q. 145. What type of interrupter was used? A. The interrupter in this case was a fuse for each individual test.

Q. 146. What do you find as the result of the test, using a fuse as an interrupter? A. The final results were more or less erratic. Out of six consecutive tests, one is entirely satisfactory. A second is quite usable. The remaining four could hardly be considered as usable, the indications only being very faint on three of them, and one has no indication whatever.

Q. 147. In the one that has no indication whatever, was that made on the same test piece? Did that test piece have any flaws in it? A. The conditions were as nearly the same in all cases as it was possible to make them under ordinary laboratory conditions.

Q. 148. And the column of figures on the left is what? A. The figures here indicate the pole strengths on the piece as measured by magnetometric method.

Q. 149. Whose name appears on the paper? A. Grant W. Coon.

Q. 150. I hand you here another sheet of paper and ask that it be marked 19 for Identification, and I ask that
93 the photograph thereof be marked 19-A for Identification.

(The paper with attached records of tests was marked "Plaintiff's Exhibit No. 19 for Identification." The photograph thereof was marked "Plaintiff's Exhibit No. 19-A for Identification.")

Q. 150. (continuing) I ask you if you can identify this paper. A. This is the results of another series of tests conducted by Grant W. Coon.

Q. 151. Under your direction and supervision? A. Yes, and the purpose here was to get a series of consecutive readings with circuits used on those previously and using a knife switch for a breaker. There is a column included which gives the magnetometer readings, as was done on all the others. The transfers indicate the actual indications that were gotten by means of the dry powder method. Of course, there are six in all, and three are fairly satisfactory. Although they could not be considered to be identical, they are very close. Two did yield slight indications but could not be considered satisfactory, and one gave no indication at all.

Q. 152. What conclusions do you draw with regard to consistency and usability of the different types of interrupters from these tests which you have conducted? A. The results of these tests show that wherever a de-ion breaker was used, or a mercury switch, results were entirely
94 consistent and entirely usable for application to commercial inspection. However, the knife switch and the fuse are both indicated as being unsatisfactory and unreliable due to the fact that the results that were gotten were not uniform.

Q. 153. I hand you another paper and ask that it be marked Plaintiff's Exhibit 20 for Identification.

(The tabulation was marked "Plaintiff's Exhibit No. 20 for Identification.")

Q. 153. (continuing) I ask you if you can identify this paper which has been marked Plaintiff's Exhibit 20 for Identification. A. I can. This is a paper which is signed

by Grant W. Coon and gives a total listing of readings taken on a large number of consecutive magnetizations made by means of magnetizing equipment identical with that used in all the previous tests, but using in one case a de-ion breaker and in the second place a knife switch. These readings were taken at my request and under my direction.

Q. 154. Are these readings of relative magnetism? A. They are.

Q. 155. And they are consecutive readings? A. They are consecutive readings.

Q. 156. What do you find from the inspection of these figures? A. Inspection shows that the de-ion was
95 consistent to an entirely satisfactory degree, as was already indicated by the previous transfer tests. In this case it was extended to—I don't know the actual number but there are at least twenty or more of them here, and the variation around an average value was very slight and there was no individual variation that was enough to be considered serious at all.

The second list of readings on the knife switch consists of approximately the same number of tests or the same number of recorded readings. However, I believe I stated that this was made with a knife switch as the breaker. In this particular series of tests, readings varied actually more than 400 per cent. In other words, there are readings in here that are more than four times some of the others that were obtained at different times. To compare them to an average, the readings are all so incongruous that an average wouldn't mean anything.

Q. 157. I notice some readings, for example, in the column labeled "knife switch," of 3.0, 3.9, and so forth. From your experience in this field, would you say there was sufficient magnetism in the test piece to give any indication of whether or not there was a flaw present? A. No, it wouldn't give any indication.

Q. 158. So that such a test would have been unsatisfactory? A. That is right.

96 Mr. Simpson: I have here a strip of film and I ask that it be marked Plaintiff's Exhibit 21 for Identification. I have a blueprint—I will refer to these as blueprints; they are what are known as black-on-white prints—made directly from the negative that is marked Exhibit 21 for Identification, and I will ask that this be marked Plaintiff's Exhibit 21-A for Identification.

(The strip of film was marked "Plaintiff's Exhibit No. 21 for Identification." The blueprint thereof was marked "Plaintiff's Exhibit No. 21-A for Identification.")

Mr. Simpson: To facilitate inspection of some of these negatives, we have a stiff white cardboard with a single black reference line over which the negative may be laid, the black reference line being for the purpose of connecting up the axis of the oscillograph record.

Q. 159. I now hand you this negative, Plaintiff's Exhibit 21, for Identification, and ask you if you can identify it.
A. Yes, I can identify this.

Q. 160. Will you state what it is, please? A. It is an oscillographic record of the current that flowed in a magnetizing circuit, such as is shown in the chart over here (Plaintiff's Exhibit 14), when the break was accomplished by means of a de-ion breaker.

97 Q. 161. Before you proceed further with a description of that negative, and in order to expedite the procedure, I am going to hand you three more and let you discuss all four of them in general, calling attention to such points as you care to.

(Three strips of film offered by Counsel were marked "Plaintiff's Exhibits No. 22, 23 and 24 for Identification," respectively. Blueprints thereof were marked "Plaintiff's Exhibits 22-A, 23-A and 24-A for Identification.")

Q. 161. (continuing) Mr. Clarke, will you refer to all four of these negatives? What type of circuit interrupter was used in the magnetizing circuit in connection with

each of these films? A. In each film the magnetizing circuit interrupter was the de-ion breaker.

Q. 162. What conclusions can you draw from these oscillograph negatives which were made of the current in the magnetizing coil? A. The first thing that probably would be noticed is the fact that the current, after having continued for a large number of cycles, is interrupted in all cases at substantially a zero point, which is indicated by a center line on some of these. On two of them it isn't indicated but there is an extension. On 21 and 22 there is no center line or reference line, but a zero point would
 98 be a straight line that was continued on through from the center. Strictly speaking, on 22 the center line would be an extension of the end to opposite the figures 40 and 41. I believe they will be readable on the prints. They are definitely on here.

Q. 163. Can you assist the Court in indicating which is the starting end or the time at which current was first put into the circuit, and indicate which end is the end which constitutes the break in the circuit? A. The actual films which I have here have been tagged at the positive end.

Q. 164. What do you mean by the positive end? A. I mean at the start end. They have been tagged at the end which indicates the start of current. Even without knowing which end is the start, though, an interpretation of the curve itself will show it, in practically all cases at least. In all the examples here, the start can definitely be shown. Whenever an alternating circuit is closed there is a condition while current is first being built up which may or may not correspond to its final state. By far the larger chance is that it will not. In other words, there will be some transient condition take place at the time the current circuit is closed. This actual condition depends on the point on the voltage cycle when a switch is closed. If it happens to be closed at the point on the voltage cycle which corresponds to a non-current point in the steady state current wave, there
 99 will be no transient effect and it will start out, but

any other point of closure will result in some sort of a transient which will mean that that curve will go off to one side or the other of the base line. In all of these cases, the curve has actually been offset to one side or the other of the base line or the reference line to the center, and eventually the transient subsides and we get down to the steady state. So by identifying this transient on here you can be definitely certain which end of the trace is the start and which is the break.

Q. 165. What do you find with reference to the point of break in each of these negatives? A. The point of break in each negative is substantially zero in the current wave. We have gone up to a maximum in one direction and returned to zero and then the current flow has ceased.

Q. 166. Do you find any substantial damping of the current just prior to break? A. No, there isn't.

Q. 167. Would you in your experience in this field draw any definite conclusions from these oscillograph records as to whether or not the piece was permanently magnetized a sufficient amount to give an indication in a test for flaws? A. This indicates that the current would be entirely satisfactory for test magnetization.

100 Mr. Simpson: I have one other negative here which I ask be marked Plaintiff's Exhibit 25 for Identification. Your Honor, I intended to include this in the general discussion of the others. I will merely ask him to identify it.

(The strip of film was marked "Plaintiff's Exhibit No. 25 for Identification." The blueprint copy thereof was marked "Plaintiff's Exhibit No. 25-A for Identification.")

Q. 168. I now hand you Plaintiff's Exhibit 25 for Identification and ask if you can identify that. A. Yes, this is another film that was made for the same purpose as the others, illustrating a break and the nature of the current when a de-ion breaker was used for magnetizing purposes.

Q. 169. And that was made on the oscilloscope which you

used in connection with the others? A. It was. It was made with the same equipment and the same oscilloscope, the same method of recording.

Mr. Simpson: I have a negative here that I ask be marked Plaintiff's Exhibit 26 for Identification; and I ask that the blueprint copy of the same negative be marked 26-A for Identification.

(Strips of film offered by Counsel were marked "Plaintiff's Exhibits 26, 27, 28 and 29 for Identification."
101 Blueprint copies thereof were marked "Plaintiff's Exhibits No. 26-A, 27-A, 28-A and 29-A for Identification.")

Q. 170. I hand these four negatives to you, Mr. Clarke, which have been marked 26, 27, 28 and 29 for Identification, and ask you if you can identify them. A. Yes, these are all oscillograph records which have been made to determine the characteristics in magnetizing currents which are interrupted by means of a fuse. There are four different films here.

Q. 171. Were different types of fuses used? A. There were. There are two different types. One test was made using an ordinary fuse of the lead foil type or a thin strip of lead or easily fusible material. The other three are all using fuse consisting of various sizes of small diameter copper wire.

Q. 172. I believe that you should explain, Mr. Clarke, the difference in the different negatives here because of the method in which the oscillograph record was made. Will you refer first to Plaintiff's Exhibit 26 for Identification, and take them up in order? A. In Exhibit 26, an attempt was made to determine a size or possibly type of fuse or a set of conditions that would permit a break at the crest of a single cycle of alternating current; in other words, only to
102 admit one cycle or a fraction of one cycle, and then interrupt the current somewhat in the manner that is described by Van Meyl in the French patent. In order to do this, a fuse of very fine wire was used.

In order to give a record of steady state conditions, the film has actually had three separate exposures. One exposure simply was made of a stationary spot in the oscillograph to record an axis line or a reference line. After that was made, another recording was made at a greatly reduced intensity of the spot in the oscillograph, showing steady state current conditions. That was done by merely shorting the switch that was around the fuse—the hand-operated knife switch in the wiring diagram exhibit.

To obtain this reference trace of a steady state current condition, a knife switch was closed. As I explained before, the fuse in all these tests was shunted around this knife switch, but now to set up a reference trace, we close that knife switch, leave the fuse out of the circuit and let current flow continually and run a trace to show what steady state current would be in that circuit. I hardly believe that that shows at all in the prints which were made off of these films. It is entirely legible on the film, though.

Then the black traces or darker traces are actually current breaks. There are three of them on here. The start on all of these can be determined in this way. If the
 103 print is held in such a position that the curve showing approximately equal cycles on both sides of the line is to the left, then the start of this film is at the right. we have the results of three breaks here. In the first, our current started approximately at zero, built up to a value much higher than the steady state current, dropped down to zero, actually reversed and built up to a low value in a reverse direction, and then returned to zero after which it ceased to flow.

Q. 173. What conclusions can you draw from the low value peak which it had just prior to the time when it cut off? A. That would have resulted in the piece being left either with no magnetization, or a very feeble one.

Q. 174. Is that similar to the situation which you earlier described in connection with the chart, Plaintiff's Exhibit 10? A. It is the same condition exactly, excepting that

there are less reversals. There were actually three reversals at the low amplitude. Here there is only one, but the effect will be the same because it is the last half cycle that determines the final field.

In the second one on this trace, which is the center one, we see that the current has started from zero and has risen to a very low value in a negative direction and then returned to zero, increased to a high value in a positive direction and then returned back to zero, and has ceased
104 to flow at zero. Actually, the amplitude here was greater than the steady state current. The interpretation of that is this: that particular application of current there would have produced a very good state of magnetization in the part. Actually a stronger magnetizing force was applied to the piece from that application of current than would have been applied had the current remained at its steady state.

Still referring to Plaintiff's Exhibit 26 for Identification, in the third one we have gone through two complete or very nearly complete half cycles. As I have the film arranged here, it starts at the right and goes down to a certain value in one direction, returns to zero, reverses and starts up in the opposite direction and goes almost up to the same peak value as would correspond to the steady state current peak value, and returns to zero. That one, again, probably would have produced a very satisfactory magnetization. It wouldn't have been as strong as the one immediately before it, however.

Q. 175. Do you find a somewhat similar situation in the one marked Plaintiff's Exhibit 27 for Identification? A. In 27 the effect is very much the same. There is one that would result in practically no magnetization. Both of the others would really result in a magnetization that was actually higher than would be anticipated from the normal value of the current.

Q. 176. What conclusions do you draw from Plaintiff's Exhibit 28 for Identification? A. The same idea of irregu-

larity is shown here. The first trace in the lot was inordinately high. The next one was somewhat lower than that. Both of those had a break at substantially zero, so they would result in very good magnetization. The third one on the firm goes first to a high value and then comes down and reverses and goes to a low value, and would have resulted in a low value magnetization in a part.

Q. 177. Would you in your experience say that that magnetization would have been sufficient to give a positive indication if tests were made? A. No, I don't think that it would.

Q. 178. Will you refer to Plaintiff's Exhibit 29 for Identification? A. This one was made with a lead fuse and was made in a somewhat different manner than the others. The fuse size here was so chosen that a considerably larger amount of heat had to build up in it. In other words, it would take an appreciable time before that fuse would blow out. Actually, then, we had a set of conditions where current could reach a normal state and then the fuse would blow, interrupting the circuit. The film is somewhat fogged on this, but the important elements of the trace itself are there, and even though it is fogged, it is a perfectly
106 readable trace on the film itself.

If we place this film so that the numbers 15 and 16 are at the right, then the start of the film will be on the right-hand side.

There are two actual traces on this film. Starting with the one to the right or the first one, we see that our current has started there. Actually, current started off the end of the film. This film in making these recordings is wrapped around a drum and that drum rotates while the spot is moved back and forth across it. Actually, the current continued from some time before the end of this film got in the path of the lens and a steady state current was reached almost immediately. Then at a point approximately opposite the word "panchromatic" on this film, the fuse blew and set up an arc which would let that current persist for

some time, and we can see from that point on that we have two and a half complete cycles after that point where the peak of each succeeding half cycle drops off considerably from the one before, the peak of the last cycle being very much lower than the one before it, and lower than the steady state current, too. That would bring about the condition that was explained from the chart this morning, Exhibit 10, where the shape of the hysteresis loop when an alternating current was decreasing in amplitude, was explained. This would result in a thorough demagnetization, or at least a low value of residual magnetization in the part.

107 The second part of this trace is with the fuse made the same way again, but the break is a normal one there and the amplitude stays fairly consistent.

Mr. Simpson: I have here a film and ask that it be marked Plaintiff's Exhibit 30 for Identification, and I have a blueprint reproduction of the film and ask that it be marked 30-A for Identification.

(Strips of film offered by Counsel were marked "Plaintiff's Exhibits No. 30 and 31 for Identification." Blueprint reproductions thereof were marked "Plaintiff's Exhibits No. 30-A and 31-A for Identification.")

Q. 179. Mr. Clarke, I hand you these two films that have been marked Plaintiff's Exhibit 30 for Identification and Plaintiff's Exhibit 31 for Identification and ask you if you can identify them. A. Yes, I recognize these films.

Q. 180. Will you tell the Court what they are, please? A. They are oscillograph records showing the results of a test to determine magnetizing conditions when a knife switch is used to break the magnetizing current.

Q. 181. Will you refer first to Plaintiff's Exhibit 30 for Identification and state what you find there? A. In this Exhibit 30, current has started and been allowed to continue for a considerable length of time. It so happened in this case that the knife switch broke at a point which al-
108 lowed current to be set up almost immediately at its steady state value. There is practically no sign of a

transient at the start. It continued for a considerable period of time and then the knife switch was opened. The current trace itself shows that there was considerable damping of the wave at the break. The last cycle is very much lower than the steady state.

Q. 182. In referring to the last cycle as being very much lower than the steady state, you mean the amplitude of the last cycle of the current wave is a very low amplitude? A. That is right. This is all a trace of current amplitude. This whole thing is actually a trace of current amplitude all the way through.

Q. 183. Is there any similarity between that oscillograph record, Plaintiff's Exhibit 30 for Identification, and the chart record, Plaintiff's Exhibit 10? A. This is a current wave which is comparable in every way to the one at the top of Exhibit 10. Actually, in this case there are more half cycles than the four or four and a half that are present in 10.

Q. 184. Will you now refer to the negative, Plaintiff's Exhibit 31 for Identification, and state what you find there?

A. This is another oscillograph record showing a test made with a knife switch. Actually, there are two tests on
109 this one film. The first shows a current that has started at something rather close to normal steady state condition and has continued on and been broken and has actually subsided at practically a zero point in the current wave without any reduction in amplitude or without an actual reversal. That one would have produced a fair magnetization.

The second trace on this film also shows current that was present in a magnetizing circuit that was controlled by a knife switch, and it starts out with a very decided transient condition, the current peak is terribly high at first, but after it subsides down to normal, we continue to the break, and the break here is again of such a nature that it would probably have produced a quite satisfactory magnetization. The variation in amplitude is quite small.

Q. 185. From your experience in this field, do you draw any conclusions with regard to whether or not a knife switch would be satisfactory for opening the alternating current circuit in magnetic flaw detection equipment? A. The magnetic flaw detecting system or method depends entirely on the absence of an indication as being indicative of the soundness of a part. There are too things that can cause the absence of that indication. One of these is that the part is sound. The second is that there has been no magnetization set up in the piece, and as a result of that, it is absolutely necessary to know that a piece is magnetized before a
 110 test is made on it. If it were a matter of testing one piece a day, or something of that sort, it would be a simple matter to attempt to magnetize, and in most cases, at least, it would be possible to check and find whether you had gotten magnetization or not; but that isn't the way things are done now. Most generally manufacture is carried out on a production line basis. A man may conduct these tests who hardly knows what he is doing. He has been told to go through this process and magnetize it, or do this or do that to it, that being a description of magnetizing the part. He has to be able to handle one of those only once and be absolutely sure that that will result in a magnetization.

Q. 186. Would you say the knife switch was satisfactory as a current interrupter? A. Due to the fact that there are so often cases where you don't get magnetization, I can't say that it would be.

Q. 187. You mean as the result of the tests which you conducted, you found there were too many times when the piece was not magnetized sufficiently to give an indication, so it would be unsatisfactory? A. It would be unsatisfactory.

Q. 188. What conclusions would you draw with respect to the desirability of using a fuse as a current interrupter?

A. The tests have shown that a fuse is also erratic,
 111 and for the same reasons given for a knife switch, it would be unsatisfactory also.

Q. 189. What conclusion would you draw from the tests which you have conducted with regard to the desirability of using a de-ion circuit breaker? A. The de-ion circuit breaker would be satisfactory.

Q. 190. What conclusion would you draw with regard to the use of a mercury switch? A. The mercury switch also would be O. K.

Q. 191. You base that on the tests which you have conducted, in addition to your experience in this field? A. The tests have shown that the two that I indicated would be satisfactory; the mercury switch and the de-ion circuit breaker are both consistent in the magnetization they leave in the part, while the fuse and knife switch aren't, and that has actually been borne out in practice in the field in commercial equipment.

Q. 192. Have you found any record here that would indicate a failure properly to magnetize the piece when a de-ion breaker was used? A. No. There have been slight variations in current peaks at the break, variations of a matter of a few per cent, but there is enough leeway permissible in the strength of magnetization that that small variation will have no effect whatever. It is when you get to a variation of three to one, four to one, or down to nothing, that the difficulties really get very serious.

Q. 193. From the tests which you have conducted, have you found any instance in which a mercury switch would fail to give a proper or sufficient amount of magnetization? A. No.

Q. 194. Have you found any instances in connection with a knife switch? A. Yes, very definitely.

Q. 195. And have you found instances in connection with the fuse? A. We have.

Q. 196. In your experience in this field and as an expert, Mr. Clarke, can you draw any similarity between the use of a knife switch and the use of metallic contact elements which are separated, such, for example, as the contacts used in the Hauser patent? A. In any switch, you have mechan-

ical surfaces which are actually drawn away from each other or taken out of contact, just the same as is done in Hauser. They are both metallic surfaces that are separated from each other and there is no other provision made for altering a break or a determination of the current.

Q. 197. The type of contacts that are employed in Hauser, then, are contacts which simulate the conditions of a
113 knife switch, is that correct? A. I would consider that they do.

Q. 198. Would you say that the contacts in the manner in which they are separated in Hauser differ from the manner in which the circuit is interrupted by a mercury switch? A. Yes. In the mercury switch there is quite a different set of conditions than in the Hauser.

Mr. Simpson: May we have a ten-minute recess? I want to check on whether another witness is going to get here. (Ten-minute recess.)

Mr. Simpson: We had one witness who is one of the vice presidents of this company, and as I stated before, he has been tied up in an important conference with the War Department, and apparently he has been unable to complete that conference, so I am going to have Mr. Clarke continue and I will bring out the points that this other man would have testified to.

Q. 199. Does Magnaflux Corporation employ any equipment commercially which uses alternating current? A. I don't understand the question.

Q. 200. Let me rephrase that question. Does Magnaflux Corporation, Plaintiff in this case, manufacture testing
equipment which uses alternating current rather than
114 direct current? A. Yes, they do.

Q. 201. How extensive is that business in connection with alternating current? A. Alternating current equipment is very popular. Since it was introduced on the market, it has been very successful and is used by a large number of our customers.

Q. 202. Was this introduced on the market after Mr. Doane made this invention which is involved in this suit?
A. It was, yes, sir.

Q. 203. And you stated that it has met with commercial popularity and that they actually manufacture and sell a large number of alternating current units. A. It did. It met with popularity.

Q. 204. Are you still selling those units? A. We are still selling them.

Q. 205. What kind of circuit interrupter do these pieces of equipment use? A. The de-ion breaker.

Q. 206. I hand you here a photograph and ask you if you recognize the photograph. A. I recognize the photograph.

Q. 207. What is it a photograph of? A. It is a photograph of one of the Magnaflux Corporation's manufacturing models. This particular model is the Type D-363.

115 Q. 208. Is that a standard unit that is manufactured by the Corporation? A. That is a standard unit.

Q. 209. And it uses alternating current? A. It uses alternating current.

Q. 210. It uses the de-ion circuit breaker? A. A de-ion is used in all of them.

Mr. Simpson: I offer this photograph in evidence as Plaintiff's Exhibit 32.

(The photograph was received in evidence and marked "Plaintiff's Exhibit No. 32.")

Q. 211. I hand you another photograph and ask you if you can identify it. A. I can identify this. This is Magnaflux Corporation's Model KR-3. It is an alternating current machine that produces magnetization by means of alternating current, and has the same breaker equipment in it, the de-ion breaker, that is used in the D-363.

Q. 212. That is one of the present commercial items? A. Those are both present items.

Mr. Simpson: I offer that as Plaintiff's Exhibit 33.

(The photograph was received in evidence and marked "Plaintiff's Exhibit No. 33.")

116 Q. 213. I hand you another photograph and ask you if you can identify it. A. That photograph shows an actual inspection setup with an alternating current machine. This machine carries the same model number as the one in the previous exhibit, KR-3. However, it is an older type that is now obsolete and was replaced by the present KR-3. In this case, it is being used in the inspection of a boiler drum by means of a magnetic field set up in that drum by means of alternating current.

Q. 214. Do you use a de-ion interrupter in that? A. A de-ion is used in that.

Q. 215. And that unit was made after Mr. Doane made the invention? A. That is right.

Mr. Simpson: I offer that as Plaintiff's Exhibit 34.

(The photograph was received in evidence and marked "Plaintiff's Exhibit No. 34.")

Q. 216. I hand you here two photographs and ask you if you can identify them. A. Those photographs are different views of an engine piston—I think it probably is a diesel engine piston, from the appearance of it, which would mean that it is an internal combustion engine.

117 Q. 217. These photographs represent an actual piece that was tested in practice? A. They do.

Q. 218. And they show a flaw indication of the type which we have discussed? A. There is an indication on both. One of them is on the outside of the piston. The other is on the inside.

Mr. Simpson: I ask you to mark the photograph having the indication on the outside as Plaintiff's Exhibit 35, and I ask you to mark the one having a flaw indication on the inside as Plaintiff's Exhibit 36, and I offer both of these photographs in evidence.

(The photographs were received in evidence and marked "Plaintiff's Exhibits No. 35 and 36.")

Mr. Simpson: I am through with the direct examination of this witness.

118 Cross-Examination

By Mr. Whitehead

XQ. 1. In this Hauser patent, you said you indicated this as a main line switch, and that this is the switch that is automatically opened when this lever is tripped and breaks the current. (Referring to Plaintiff's Exhibit No. 12) A. That is right.

XQ. 2. That isn't the switch which you use back here somewhere for throwing the current on? A. No, you couldn't term that as a master control switch.

XQ. 3. You marked it main line switch, and I wanted to make it clear that it has the same action as a mercury vapor switch. It corresponds to the mercury vapor switch in your setup, does it not? A. As far as location in the circuit is concerned, you mean?

XQ. 4. I mean as far as breaking the line. A. It is the one that breaks the magnetizing current, yes.

XQ. 5. If you look at the specifications of the British patent, he starts out by saying his invention relates to a magnetizing apparatus for operation with alternating current (in line 14, first column), then he says, "In magnetizing devices, the coils of which for the generation of the magnetizing field are supplied with alternating current, it has
119 hitherto proved a matter of difficulty in the first place to utilize the greatest strength of the alternating field for the magnetizing process, and secondly, to determine in advance the polarity of the object to be magnetized." What do you understand that to mean? A. I believe the text is rather clear in this case. The actual statement is that previous to the time of this patent, it has been difficult to utilize or make use of the maximum available magnetizing force in the alternating current, or due to the alternating current, rather; and then his second statement is merely that you aren't sure with what polarity a piece is to be magnetized after it has been magnetized.

XQ. 6. That is a statement, that using the alternating current, as has been done, you couldn't be sure of getting both. A. That is right. His statement is really that it was difficult to obtain—

XQ. 7. (Interposing) —to obtain both.

Now then he said, "With a hand-operated switch, it is obviously impossible to effect with any certainty the interruption at the right moment of the alternating current traversing the magnetizing coil." His next sentence after that says, "But even interruption at the neutral point" By "neutral point," doesn't he mean the zero point of the current? A. I think that could be construed, although it isn't too definitely stated. Just as I say, that statement as it stands would not—

XQ. 8. (Interposing) I am trying to ask you this: Take the two sentences together, the one I just read, talking about an alternating current traversing the magnetizing coil; now he says, "Even interruption" Isn't he talking about the interruption of the current that he is talking about in the sentence before? That is right, isn't it? A. I believe it is.

XQ. 9. He goes on to say, "But even interruption at the neutral point," and then he puts in a parenthetical clause; "As already proposed for the primary circuit of a transformer field with alternating current which could also be used as a magnetizing apparatus," and then he says, "merely insures the interruption at a moment at which the field of the secondary winding possesses its maximum strength." Isn't that a statement that if you break the current at the zero point in this magnetizing circuit, you will have your magnetizing force at its maximum strength? Isn't that what he said? A. Even interruption at the neutral point merely insures the interruption at the moment in which the field of the secondary winding possesses its maximum strength. That is a statement he makes there that applies to the transformer itself, and he speaks of the field in the secondary.

XQ. 10. Let me interrupt you a minute. Suppose
 121 you leave out the parenthetical clause and read it this way: "Even interruption at the neutral point merely insures the interruption at a moment at which the field of the secondary winding possesses its maximum strength." He is talking about a current to magnetize an article with, an alternating current for magnetization. A. That would be true, what he says there, if it were possible to conceive of primary current and secondary current being 90 degrees out of phase.

XQ. 11. And yet he goes on to say, "but not the attainment of the desired polarity of the object to be magnetized." He says there were two things you couldn't get before. If you break it at the zero point, you get one, but even then you don't get the other. Isn't that what he is saying in that language? A. That is what he says here, yes; you don't get the other, "the other" here referring to the desired polarity.

XQ. 12. Yes, he says he starts out with two things: to break when the magnetization is at the maximum, and to get the right polarity. He says if you break at zero, you will get one but you won't get the other. That is his statement, isn't it? A. That is his statement, yes.

Mr. Whitehead: That is all.

122 Redirect Examination by Mr. Simpson.

RDQ. 1. Mr. Clarke, do you find any place in the Hauser patent at all a teaching of how to open at zero? A. No.

RDQ. 2. Can you open at zero with the apparatus which he has shown? A. With the apparatus that he has shown, I don't think it can be done.

RDQ. 3. This same phrase that Mr. Whitehead has called to your attention here, beginning on line 28, page 1, suggests some thought that if interruption occurs at the neutral point in the primary circuit of the transformer, you may obtain interruption of the current in the secondary at a moment in which the field of the secondary winding possesses

its maximum strength. When does a field possess its maximum strength, at the crest of the current wave or at the zero point? A. A field possesses its maximum strength at the crest of the current wave.

RDQ. 4. So what we find here in Hauser is that you are going to open the primary at the neutral point in order to obtain an opening of the secondary current at the crest; is that the way you interpret that? A. To make a definite statement on this is awfully hard, because I think that the phrasing is very ambiguous in this particular state-
123 ment here. He speaks about the secondary winding, and that will imply current in the secondary circuit, of course, and if that is the case, it is a condition that couldn't exist, because you would have current flowing in the secondary of the transfer and none in the primary.

Mr. Simpson: That is all.

By the Court:

Q. 1. The mercury switch has been known to the art for years and years, hasn't it? A. Yes, it has been.

Q. 2. And it has been used in electrical science. A. It has been used in various ways.

Q. 3. And also the other switch, the de-ion switch has been known to the art for some time. A. It was used for some time for motor starting and line operation.

Q. 4. And of course the magnetizing of a piece of steel or iron by the alternating current that we are speaking of here has been known for some time. A. It was known or thought that it could be done, and it was known that it could be done in a random fashion.

Q. 5. The British patent mentions that the alternating current is used, doesn't it? A. His is an attempt to use alternating current.

Q. 6. But he says, doesn't he, that it was used? A.
124 His device is for that purpose of using alternating current.

Q. 7. You have read the patent, haven't you? A. Yes.

Q. 8. Doesn't it say so? He uses an alternating current, doesn't he? A. Hauser's device uses alternating current, yes, sir.

Q. 9. You claim that all these experiments that you have made, these exhibits, and so on, show that the use of the mercury switch or the de-ion switch gets more accurate or better results when used with this alternating current than these other switches? A. That is right. It has actually proved out commercially. We can't use anything else. Even at times when we can't get them and would like to use the others, we can't.

The Court: I notice that the De Forest patent, No. 2,110,759 was applied for July 19, 1935, and I notice that it was assigned by De Forest to the Magnaflux Corporation. Is that the plaintiff here?

Mr. Simpson: Yes, sir.

Mr. Whitehead: May I just say to the Court that the patent doesn't go against the first two claims because they came out of an application that was filed earlier than this Doane application.

The Court: I notice that.

125 Mr. Simpson: I would like to ask this witness one more question prompted by the questions you have asked.

RDQ. 5. Mr. Clarke, do you find anywhere in the references here a suggestion or a realization that you should use a circuit interrupting means which will insure interruption of the current at the zero point of the current cycle? A. The inference is that you should use something beyond that, due to that word "even." He says even interruption doesn't accomplish all these things that are desired.

RDQ. 6. But do you find any teaching in there that definitely suggests the use of an interrupting means that opens at the zero point of the current cycle? A. No, there is nothing in there that will actually suggest it at all.

RDQ. 7. In any of the references? A. No.

RDQ. 8. Is there anything in the references that shows either a mercury switch or a de-ion switch in a magnetizing circuit? A. No, there is nothing in any of the references that shows either of the two.

The Court: The Hauser patent uses the expression, "at the neutral point." He doesn't say "at a neutral point."

Isn't there only one neutral point, and isn't that zero?

126 Mr. Simpson: I think you should read the rest of the sentence.

The Witness: That is what I was questioning about the neutral point.

The Court: The sentence was read by Mr. Whitehead.

Mr. Simpson: The reference to the neutral point is where he is referring to the primary circuit or secondary circuit.

The Court: No matter whether it is primary or secondary, I am talking about those words as used in electrical and magnetic matters. When you talk about "at *the* neutral point," not "at *a* neutral point," there must be only one neutral point, the way that expression is used. Isn't that so?

The Witness: A neutral point is referred to, and would necessarily have to be referred to in regard to some other reference point. For instance, in a three-wire distribution system, which is common, there is one wire which is called a neutral and this is the most common usage of the word in electrical parlance. There is one wire which is termed a neutral wire and that is midway in its voltage at all times between the two extreme wires. If it is a 220 volt distribution system, the neutral will be 110 volts off or away from one in potential, and it will also be 110 volts away
127 from the other. It wouldn't necessarily be at zero, though. Neutral and zero are hardly the same.

The Court: You are speaking of the third wire as a neutral wire, but that is different from a neutral point in a current.

The Witness: The neutral wire represents the average between those two outside ones, or the outside point.

Mr. Whitehead: It was well known that in these patents with these mercury vapor switches, you break at the zero point. It is a common property of all of these mercury vapor switches that they break at the neutral point, at the zero point.

The Witness: At the zero point, yes.

Mr. Whitehead: And that was known and that is so stated in the application in suit, is it not?

The Witness: In the Doane application, you mean? Yes.

128 Mr. Simpson: I want to call Mr. Grant Coon.

Grant W. Coon, called as a witness in behalf of the Plaintiff, being duly sworn, testified as follows:

Direct Examination

By Mr. Simpson

Q. 1. Please state your name, age and residence. A. Grant W. Coon, age 31, residence 5426 North Mobile, Chicago.

Q. 2. By whom are you now employed? A. By the Magnaflux Corporation.

Q. 3. In what capacity? A. As experimental engineer; research in magnetism.

Q. 4. What are your principal duties in your present job? A. My principal duties are testing newly designed equipment to see how it works, and thinking of ways to improve present apparatus.

Q. 5. How long have you worked for Magnaflux? A. One year and eight months.

Q. 6. What training in engineering and physics have you had? A. I have a B.A. degree in physics and mathematics.

Q. 7. Where did you work before you came with Magnaflux? A. I worked for the Clough-Bringle Company.

Q. 8. Where is that located? A. At 5505 North Broadway, at the present time.

Q. 9. What, generally, was the nature of your work there? A. My work was testing, inspecting and repairing radio circuits.

129

Q. 10. Have you recently carried out a series of tests relating to permanent magnetization of steel objects using different types of alternating current circuits? A. I have.

Q. 11. Under whose direction and supervision were these tests carried out? A. Under the direction and supervision of Mr. Clarke.

Q. 12. John E. Clarke? A. John E. Clarke.

Q. 13. What was the purpose of these tests? A. The purpose of these tests was to magnetize steel parts in a coil and determine what type of breakers gave erratic results, if any, and what type gave consistent results.

Q. 14. And what different types of circuits did you use? A. I used different types of circuits, but mainly the circuit which was shown in this diagram Mr. Clarke referred to.

Q. 15. Which diagram are you referring to? A. I am referring to the bottom diagram on this Plaintiff's Exhibit 14.

Q. 16. Did you run tests using a knife switch to open an alternating current circuit? A. I did.

130 Q. 17. Did you run tests using a fuse to open an alternating current circuit? A. Yes.

Q. 18. Did you run tests using a de-ion breaker to open an alternating current circuit? A. Yes.

Q. 19. Did you run tests using a mercury switch to open alternating current circuits? A. I did.

Q. 20. Describe very briefly what the apparatus was that you used. A. The apparatus I used was a 28 x 14 inch magnetic testing coil, one of our standard coils, and a Westinghouse de-ion breaker which is shown in the diagram, with auxiliary breaker coil used for closing and opening the contacts, a knife switch which contained a handle that was operated by hand, and the resistance referred to in that diagram is composed of a piece of carbon from a carbon pile resistor.

Q. 21. When you were conducting these tests, did you close the knife switch when you were operating the de-ion breaker? A. Yes, I closed the knife switch, and in taking

the pictures, an assistant opened the shutter of the drum camera and placed it in front of the oscilloscope.

Q. 22. When you opened the knife switch, what
131 position was the de-ion breaker in? A. The de-ion breaker was then closed.

Q. 23. Where did you insert the fuse in the circuit when interrupting it? A. The fuse was inserted in place of the knife switch.

Q. 24. Where was the mercury switch inserted in the circuit? A. In substitution for the knife switch.

Q. 25. In both of these instances, how did you determine the relative magnetization after the magnetizing force was removed? A. I determined the relative magnetization by means of a magnetometer.

Q. 26. Will you describe very briefly what that is? A. The magnetometer, briefly, is a magnetic compass placed at the zero portion of a meter stick so that the meter stick is at right angles to the north and south markings on the compass. The test piece or magnetized cylinder was placed above the compass parallel to the meter stick, and was moved back and forth until a 50 degree deflection was obtained on the compass.

Q. 27. And that gives you an indication of the relative magnetism left in the piece after it has been magnetized? A. Yes. If it has been magnetized strongly it could be moved farther away from the compass to obtain 50
132 degree deflection. If it is weakly magnetized, it has to be moved closer.

Q. 28. Is that a reliable method of testing the relative amount of magnetization in a magnetized object? A. Yes, it is reliable because you are using as a balance the earth's magnetic field which is rather constant.

The Court: Couldn't you summarize this witness' testimony by asking him with regard to what he heard Mr. Clarke testify to, whether all that is in these exhibits signed by him is accurate?

Mr. Simpson: That is agreeable with me.

The Court: That would save a great deal of time and wouldn't hurt your case any. You could ask him about all the various exhibits that Mr. Clarke identified and that you had marked for identification, so that this witness may, in conjunction with Mr. Clarke, identify them.

I think you made these tests together, didn't you?

The Witness: Yes. They were made under his supervision.

Q. 29. Mr. Coon, you have heard the testimony which Mr. Clarke has given in this case and you have seen a large number of exhibits which were marked for identification, which included a number of record sheets having Scotch transfer records made on them; another sheet which contained
133 two columns of figures, one giving readings with a de-ion breaker and one giving readings with a knife switch. You have also heard Mr. Clarke's testimony with regard to a large number of oscillograph negatives. I ask you at this time whether you made the tests and made the records which Mr. Clarke has testified to. A. Yes, I did make the tests.

The Court: They cover your exhibits for the Plaintiff, Nos. 15 to 20, both inclusive.

Q. 30. I hand you here this group of exhibits 15 to 20, inclusive, and ask you if these are the records which you made. A. Yes, they are.

The Court: And they are all signed by you?

The Witness: Yes, sir.

Mr. Simpson: Without laying any further foundation and with the approval of Counsel for the Defendant, I offer these exhibits in evidence.

The Court: They may be received.

(The record sheets previously marked "Plaintiff's Exhibits No. 15, 15-A, 16, 16-A, 17, 17-A, 18, 18-A, 19, 19-A and 20 for Identification," were received in evidence as Plaintiff's Exhibits No. 15, 15-A, 16, 16-A, 17, 17-A, 18, 18-A, 19, 19-A, and 20.)

Q. 31. Plaintiff's exhibits 21 to 31 for Identification are all negatives of oscillograph records. Were these records made while you conducted the tests? A. Yes.

134 Q. 32. And in your presence? A. Yes.

Q. 33. They were turned over to you as soon as the negative was developed? A. Yes.

Q. 34. You were present while they were being developed? A. I was at times in the dark room.

Mr. Simpson: With Mr. Whitehead's approval and without laying further foundation, I offer these oscillograph records in evidence as Plaintiff's Exhibits 21 to 31, inclusive. I also offer in evidence the blueprints, marked 21-A to 31-A, inclusive, which are copies of them.

The Court: They may be received.

(The oscillograph records previously marked "Plaintiff's Exhibits No. 21 to 31 for Identification" were received in evidence as Plaintiff's Exhibits No. 21 to 31, inclusive. The blueprints thereof previously marked "Plaintiff's Exhibits No. 21-A to 31-A for Identification" were received in evidence as Plaintiff's Exhibits No. 21-A to 31-A, inclusive.)

Q. 35. With reference to Plaintiff's Exhibit 20, do these represent all of the readings which were made at the time these particular tests were made? A. Yes, they do.

135 Q. 36. They are consecutive readings and they are the complete list of the readings that were made? A. These are consecutive and the original.

Q. 37. I hand you here Plaintiff's Exhibit 7 and ask you if you can identify that. A. Yes, I can identify it, and especially by the indications on the piece.

Q. 38. Is that the piece that was used in connection with the records that were made and that were placed by Scotch transfer tape on certain sheets of paper? A. Yes. The transfers in Exhibits 15 to 19 will show that.

Q. 39. Those readings were made in connection with this particular piece here? A. Yes.

Mr. Simpson: Your Honor, I have spoken to Mr. Whitehead about one point, and that is that there was another test piece that was used in connection with the readings which are made on Plaintiff's Exhibit 20. It is a piece of ordnance equipment and we prefer not to make any detailed description of what the piece of ordnance equipment is. It doesn't make any difference as far as this case is concerned, except that it was an object that could be magnetized and it was the same object used throughout all the tests.

136 That is all I have.

The Court: Did you want to ask this witness whether his findings in these various exhibits that were made agree with those of Mr. Clarke? I think you had better summarize it in that way.

Q. 40. What conclusions do you draw from these tests which you ran? A. I conclude that the last peak of the current as shown by this chart must be maximum in order to get maximum magnetization.

Q. 41. You are referring to the chart marked Plaintiff's Exhibit 10? A. Yes. At the top of this chart, K is not a maximum peak. B and B' are, and the Westinghouse de-ion breaker gives a maximum peak at the last half cycle, and thus, also, maximum magnetization. This is shown by the photographs.

Q. 42. And what did you find in connection with the mercury switch? A. The mercury switch also gave a maximum peak.

Q. 43. At the last half cycle? A. At the last half cycle, and maximum magnetization as shown by the magnetometer.

Q. 44. What did you find with regard to the dependability of the knife switch or fuse? A. With the knife switch,
137 at times the last half cycle was the maximum peak, but at other times it was not. Other times it was very low. That is, sometimes the last half cycle, when using the knife switch, was as low as the last half cycle in that diagram.

Q. 45. You are referring to Plaintiff's Exhibit 10, and to the top figure? A. Yes, I am referring to K on the diagram.

This is also true with the fuse. The last half cycle, which is the magnetizing current last effective on the part, is many times low.

Q. 46. Indicating that there would be very little, if any, magnetization? A. Very little magnetization, and the magnetometer also bore this out.

Q. 47. Did you find this to be true when you made magnetometer readings of the specimen? A. Yes, the pictures have appended to them tags to show the magnetometer readings. Where the peak is high, the magnetometer is high. Where the peak is low, the magnetometer reading is low. I refer to the last peak.

Q. 48. What conclusions do you draw from the Scotch transfers? What conclusions do you draw from the tests which you made actually spreading paramagnetic particles on the magnetized object? A. When the magnetometer reading was high, indicating a high last peak, 138 then the indication was strong; the powder clung strongly to the cracks, which we desire in Magnaflux testing.

Q. 49. Did you find that you always got an indication with the de-ion breaker when you were using powder to make the test? A. Yes.

Q. 50. Did you always get a reading or an indication when the object had been magnetized with a circuit using a mercury switch to interrupt the current? A. Yes, I did.

Q. 51. You always got an indication with the powder? A. Yes.

Q. 52. Did you always get an indication with the powder when a knife switch was used? A. Not always. Sometimes an indication was obtained. At other times there was no indication whatsoever, and the magnetometer reading in that case was always very low, corroborating that evidence.

Q. 53. And what did you find in connection with the fuse? A. I found the same results with the fuse as with the knife switch; in other words, erratic results, low peaks and the absence of indications at times.

Q. 54. In your experience in this field, would you draw the conclusion that the knife switch or the fuse are entirely unworkable and undesirable in magnetic testing of material for flaws? A. Under the different conditions that I have used, I have found this to be true. The evidence that we have here shows that to be true.

Q. 55. But would you draw the conclusion that the de-ion breaker or mercury switch were satisfactory and dependable and reliable from the tests which were made? A. Yes, they are.

Q. 56. Mr. Coon, have you examined the disclosure of that British patent to Hauser? A. I have looked at it, yes. I have read the patent.

Q. 57. Do you find anything in the actual apparatus which is shown and described in there which would suggest to you that it could open at the zero point of the current cycle? A. It could be adjusted so that it might at times, but—at the zero point?

Q. 58. Yes. I believe you will find in there a reference to the crest of the cycle. A. No, not at the zero point of the cycle. It claims it will open at the crest of the cycle.

Q. 59. But you don't find anything that says it can open at the zero point? A. No.

Mr. Simpson: That is all.

Mr. Whitehead: No questions.

140 I will introduce in evidence the folder containing the following items:

A—Wilson patent,	533,938
B—Hewitt,	799,052
C—Kraus,	1,046,086
D—Slepian,	1,932,090
E—De Forest,	2,110,759
F—Van Meyl, French,	593,863
G—Hauser, British	379,337
H—Print of Drawings	
I—Examiner's Statement	
J Decision of Board of Appeals	
K—Decision of Board of Appeals on Request for Reconsideration.	

The Court: That will be admitted in evidence.

(The folder containing the items listed above was received in evidence and marked "Defendant's Exhibit No. 1.")

The Court: That is all the testimony that both sides have to offer?

Mr. Simpson: That is right.

The Court: Do you want to summarize for a few minutes, or do you think it is necessary? I will be glad to give you a little while if you want to summarize.

Mr. Simpson: May I ask Your Honor, are you go-
141 ing to permit us to file briefs?

The Court: I don't usually use briefs. If you would like to file a brief statement, or make it now, summarizing the case, you may do so.

Mr. Simpson: If Your Honor would give us three days, it might expedite matters just to point out very briefly some of the points involved.

The Court: You may have three days, and Mr. Whitehead three days to reply, so you can send a copy to my clerk or mail it to me; and Mr. Whitehead, you can mail me a copy of your reply brief. Then if you want to have the testimony written up by that time, well and good, but I don't want you to go to that expense for me. Whatever you wish about that. Maybe you would rather have it written up.

Mr. Simpson: I would like to have the opportunity to file a brief memorandum.

The Court: Very well.

Mr. Simpson: I might make just a very brief statement now, if I may.

The Court: Now is the time when you could briefly give your answer to the opinions of the Examiner and the Board of Appeals, as I indicated this morning.

Mr. Simpson: The position that the Plaintiff takes in this case is that there was a very special problem in connection
142 with the use of test equipment, or the use of magnetizing circuits in test equipment. There is no question but that there are suggestions in the prior art

that alternating current may be used in magnetizing circuits. We admit that. There is no controversy about that. The thing is that these suggestions that alternating current may be used in a magnetizing circuit relate to the use of this alternating current magnetization under situations and under circumstances where it doesn't make any difference whether you have dependability or not.

The French patent is one of two patents that suggests alternating current in a magnetizing current. He is interested in magnetizing a permanent magnet. It doesn't make any difference to him whether he gets magnetization of it the first time. If he doesn't get it the first time, he will get it the second time because he can take the magnet off and put a bar on it and if it sticks on, it is magnetized and he turns it out to the trade. As a matter of fact, there is even that suggestion right in the French patent. They say if you don't get what you want the first time, do it again. We find thus in the French patent that there is actual realization of the shortcomings of using alternating current.

People wanted to use alternating current because, under certain circumstances, it was much more convenient than direct current. We commonly have in the United States today alternating current power supply. At one time
 143 direct current was rather widely used, but now alternating current is almost universally used. If you want to use direct current for magnetizing the object, you have to have special equipment. Alternating current apparatus is cheaper than direct current apparatus, and people would wish to use alternating current if they could find a reliable and dependable way always to get magnetization.

In the only other reference in the prior art relied on by the Patent Office which suggests the use of alternating current in the magnetic circuit, we find again that there is no suggestion that they are using that in a situation where it is important and necessary or desirable that you always get magnetization the first time that you try, and that is the

British patent to Hauser. That is all we have in the prior art that the Patent Office relied on.

It was old to use mercury switches and it was old to use these de-ion breakers. We admit that; there is no question about it; there is no controversy about it. But nobody used one of these mercury switches in an alternating current magnetization circuit and nobody used one of these de-ion breakers in a magnetization circuit. Now we have a man who comes along here and he realizes what is necessary to have in an alternating current magnetization circuit where you must have dependability, where you must have absolute

100 per cent workability of the system, and that is the
144 applicant here. That is Doane. He realizes, first, that you must have some type of circuit arrangement which will give uniform results 100 per cent of the time; not 99 out of 100 times but 100 per cent of the time. It isn't a question of degree between one thing and another. You have to go all the way or you haven't gone anywhere. If you haven't gone all the way, industry can't use that equipment, and that is actually what happened.

Back a number of years before Doane filed this application, people would have liked to use alternating current because it was convenient, but they didn't use it, and then we have a man who comes along and he realizes first the problem, and then he realizes the solution to that problem, and we believe that the realization of this problem and the solution of this problem amounts to invention. He has taken certain things that were old and he has brought them over and he has combined them with certain other things that were old, but he gets a new result. He gets something that none of these people got before. He got reliability and assurance that you would always get magnetization in the test piece.

That is where we contend that the Patent Office has overlooked the essence of this Doane invention. We believe that they have overlooked this last step forward in the art which Doane has taken.

We have had testimony here with regard to what the British patent shows. You have before you a copy of the
 145 British patent. I think you will readily see from examination of that British patent that Hauser was interested in one thing, and one thing only. He was interested in getting a polarized relay in an alternating current magnetization circuit. He wasn't interested in having 100 per cent reliability of the circuit. He was interested in getting something in which you could always be sure, or reasonably sure, of getting a north pole instead of a south pole. It didn't make any difference to him whether he got a good deal of magnetism for the north pole or whether he got just a little magnetism for his north pole. He had a problem. He came along and he attempted to solve it by providing his polarized relay so that he could determine the polarity of the magnetism which was given to the particular piece that he was attempting to magnetize.

We find also the entire underlying spirit of this British patent is the idea that he is trying to find some way to open at the crest of the current cycle. To him that is the only way that you can solve this problem of determining the polarity. We are not interested in polarity in our problem. We are interested in something different. He wasn't interested in dependability or reliability. We are interested in that. He was not.

As I say, he thinks that the important thing is to open at the crest of the current cycle. The testimony in this case
 has shown that if you attempt to open this wave at
 146 the crest of the current cycle, you create a big arc.

Probably you, yourself, many times have seen someone pull a switch and you have seen an arc jump between the contacts, and the more current you have, the bigger that arc is. If you have a circuit that has got several hundred amperes in it, you can sometimes even burn the metal of the switch right in two. But as you pull the switch you pull an arc, and bringing that arc out introduces something that wasn't in the circuit before; it introduces a large amount of

resistance, and when this resistance is introduced in the circuit, it causes a very marked decrease in the current flow. The result is that when you attempt to open a wave at the crest of the current cycle, you create a condition that gives you a damped wave, such as that which is illustrated in the chart marked Plaintiff's Exhibit 10.

On page 2 of the Board of Appeal's decision on request for reconsideration, the Board themselves, on rendering the decision on this, said: "If the appellant were the first to recognize that a magnetizing circuit could be opened at zero point without sacrifice of magnetizing efficiency, there might be some element of patentability in the subject matter appeal." Just look at that statement there. They are not taking an abstract consideration of the problem and saying that "if the appellant here was the first to recognize that a switch could be opened at the zero point"; they are
 147 saying in this situation, "If he were the first to recognize that it could be opened at zero point without sacrifice of magnetizing efficiency, there might be some element of patentability in the subject matter appeal."

They go on and say, "It was for the purpose of showing that the appellant was not the first to recognize this that we call specific attention to the Hauser patent." We believe very strongly that the Hauser patent contains no teaching whatsoever that you can open the magnetizing circuit at zero point without sacrifice of magnetizing efficiency. Hauser is talking always about the crest. That is what his apparatus is. There has been considerable discussion here about what one somewhat ambiguous statement is in the introductory paragraphs of the Hauser patent. To me it doesn't seem to be important whether that statement is ambiguous or whether it is clear, because Hauser has not shown, nor has he taught the public any way in which to carry out that result. He is talking about something which is not the thing which he has illustrated and described in his own patent.

Now, the Board of Appeals in their final decision relied almost entirely, I would say, on this Hauser patent. Previous to that time, the Examiner relied to a considerable degree on the French patent of Van Meyl. We have pointed out by our testimony here than Van Meyl merely has a fuse for interrupting. We have shown you the result of 148 tests using a fuse in the circuit, and we have shown that a fuse will not give you consistent results; it is not reliable; it cannot be used in a circuit for flaw detecting purposes. We don't believe there is any suggestion in the Van Meyl patent that you can open a circuit at the zero point of the current cycle.

In another place, the Board of Appeals pointed out that "Appellant's expedient of opening the circuit at the zero point is in no way superior to opening the circuit at the crest of the wave for appellant's arrangement is an expedient which can be utilized without any substantial sacrifice of efficiency."

The Board of appeals throughout the whole decision seems to have the idea that Doane has come along with something which is almost as good as Hauser, who tries to open at the crest of the current wave, but not quite as good. Contrary to that fact, the type of circuit which is described in the Doane operation is far superior to that described in the Hauser application. We can go even farther and say that it is a workable circuit for the purpose to which this circuit is to be put, and the Hauser patent is not a workable circuit.

The Board of Appeals, too, in rendering their decision, seemed to be laboring under many misunderstandings of vital features of some of these parallel references. I won't attempt to call attention to all of these now—I will point those out in the brief. But they pointed out that in 149 closing the switch of the Hauser patent the circuit will be at or about the neutral point, at the neutral point. I don't know what foundation they have for making a statement like that. Switch 5 is the relay switch in

the circuit, and according to the teachings of the Hauser patent, what he is trying to get at is that the first maximum peak cycle of the wave that comes along thereafter which is of the right polarity will cause an operation of the relay which in turn will cause a movement of this mechanical arm which opens the switch in the magnetizing circuit. According to Hauser's own teachings, if that mechanical system had no inertia at all—and that is according to what his teachings are—that switch in the magnetizing circuit would also open the crest of the current cycle. So when the Board of Appeals made a statement that the circuit would apparently be at the neutral point of the wave through the shunt, it is readily understood that the Board failed to appreciate just what was present in the Hauser, circuit, what was present in the Hauser patent, and what the Hauser teaching was.

In closing, I might say that the applicant in this case is trying to cover by the three claims that we have involved in this suit only the specific thing for which he effected the solution. He is not trying to cover the broad use of the mercury switch. That was old. But he came along and

150 he realized that a problem existed in this particular field, and he brought the necessary elements together, and that provided the result that was desired, and that is exactly and specifically what the claim defines. Before Doane made this invention, alternating current wasn't used in this field at all. After he made this invention, it met with very extensive commercial success. That is persuasive of the fact that this thing which Doane did and which the industry would have been tickled to death to have many years before that, when they were struggling along with direct current, but didn't see, is a definite contribution to the advancement of this particular art.

We feel that this step forward in the art is a real one and a definite one and a patentable one, and for that reason we are seeking a patent covering that system.

In the short brief that I will file, I will refer to some legal authorities which discuss these particular points that I have reference to here. I don't know that you would care to have me discuss those now. I am prepared to if you wish.

The Court: You may put those in the brief.

Mr. Whitehead: May I say one word more? The point I call attention to particularly, and that is use of alternating current in magnetizing articles to test, is no revolutionary invention. The only reason he gives in his application

151 for using alternating current is the matter of convenience, because you don't have to use direct current, and once you magnetize your article, it doesn't make any difference how you magnetize it, it is magnetized and you can make these very same tests the very same way. The application says that it is convenient, it is cheaper, because if you have only alternating current and you are going to use a direct current means for magnetizing your articles, you have to use a rectifier or some piece of mechanism by which you get from alternating to direct current. The original application named this thing as a method of magnetizing. The amended application calls it a magnetic testing method.

This invention, if it is an invention, stops short of the testing, and the invention is alleged to be putting a mercury vapor breaker in the circuit, or this de-ion breaker, so when you do break the electric circuit it will break in the zero point of the circuit, that you get the most magnetism left in the article to be magnetized.

The question isn't of its utility. We don't want to deny its utility, but the Supreme Court in one of its more recent cases, the Cuno Engineering Co. v. Automatic Devices Corp., has this quotation as to the difference between invention and superiority. It wound up with this statement: "That is to say, the new device, however useful it may be, must reveal the flash of creative genius, not merely the skill of the calling. If it fails, it has not established its
152 right to a private grant on the public domain."

The Court has said repeatedly in its decisions that it was the lack of invention on which they were refusing this patent.

In the Hauser patent he wanted to get his polarity and get the north and south poles at the right end of his magnet, and he went on to say that even if you broke the current at the zero point, all you would get would be the maximum efficiency of the magnetizing, but you wouldn't get the other thing he wanted. As I read it, he means he knew he could do the other, but he didn't do it because it wouldn't do both the things he wanted.

In the French patent, he didn't limit it to fuses. True, he didn't describe any particular interrupter, but he does say instead of using a fuse you can use an interrupter in the circuit, and interrupters are well known. The mercury circuit breaker was known at that time. It was known when you took the statement of the Hauser patent that if you broke your circuit at the zero point, you got the greatest magnetization, you got your maximum magnetization. It was perfectly known from this article that if you put in a breaker of the mercury type or de-ion type you would break at a lower point, because it says so in so many words. It is said in this very case that the mercury breaker or interrupter breaks the circuit at the zero point, so we say what

153 he did was known in the art already, and it may be a seeming hardship, but you have got to find invention before you can find patentability. This is the holding of the Board and it is the argument of the Board and this isn't the case to say that a man has revolutionized the art and made it possible for the first time to use this magnetic method. He isn't claiming that, and it is only a different means of using the alternating current that he is after, using it more effectively, but that is not revolutionizing the art of magnetic testing.

The Court: Do you say that the fuse switch or the knife switch would break the current at zero point?

Mr. Whitehead: I don't say that, no, sir; I don't know. There is no evidence in there to show that. They say this—both this applicant and the Hauser patent—that you can't break it with any certainty with a hand-operated switch; I take it that would mean such as a knife switch. They both say that.

The Court: If the fuse switch or the knife switch is regulated by voltage current, there is no reason why you couldn't fix it to operate when the current was at zero.

Mr. Whitehead: When you speak of the ordinary knife switch you usually mean the ordinary hand-operated switch.

The Court: I was thinking of its being operated like the Hauser one. The switch is operated by a magnetic attraction there, isn't it?

154 Mr. Whitehead: The switch is operated by a mechanism put in a shunt circuit to the magnetizing circuit. He puts it in there in connection with the permanent magnet so as to make it break at the proper polarity for his article to be magnetized.

The Court: So much for that. Then take the mercury breaker or switch and the de-ion breaker or switch. Do you admit that they must necessarily break in or stop the circuit at zero, or may they not do it at some other point?

Mr. Whitehead: My understanding of the mercury switch is that they all break at the zero point. That is the statement in the patent itself.

The Court: And the de-ion breaker also?

Mr. Whitehead: I can't answer that, whether it is true of the de-ion. It is true of the others.

The Court: If it isn't true of either one, then there is a question of trying them out to see where they will get the greatest magnetism.

Mr. Whitehead: So far as the mercury switch, there is nothing to be drawn out; that is known.

The Court: Then if that was known, to apply that to an alternating current to magnetize the article was bound to follow, wasn't it? That is what you contend?

Mr. Whitehead: Yes.

Mr. Simpson: I might make reference to two
 155 things. One is in connection with the last statement
 that Your Honor made here, that if the characteristics of a mercury switch were known, the use of the mercury switch in alternating current magnetizing circuit was bound to follow. The fact is that it didn't follow until this applicant came along. These patents of the mercury vapor switch are very old patents that they have relied on. They go back to 1895 and people didn't use them.

The Court: You mean they didn't follow because no one had used the two things together.

Mr. Simpson: They didn't realize that they wanted to or it was desirable to use the two things together. They hadn't brought them together, and yet direct current magnetizing tests were developed a long time before this particular applicant developed this arrangement for using alternating current in a test. So I don't think that we can say with any fairness that you necessarily take this next step upon the understanding that the mercury vapor switch would open the current at the zero point of the current cycle. One of these references is 1895, another 1905 and another 1912. The French patent is 1925. People didn't use it. It took this man to come along, and as soon as he did come along and as soon as he did do this thing, the thing met with immediate commercial success. After he did it and after he had solved the problem here, it was at once apparent that

it was a very desirable thing to have. There are
 156 many decisions on the case of inventions that after
 they are made frequently seem very simple. The Supreme Court of the United States has expressed that thought in many decisions. Mr. Whitehead here has referred to this French patent and the British patent, and he says probably what they intended was this. It is very well to accept a principle of patent law that foreign references particularly must be taken on their face for what they actually teach people to do. Merely veiled suggestions in these

foreign patents of what might have been done, which they didn't do, which they didn't tell you how to do, cannot be considered as proper anticipations of an invention which has been made in this country.

The basis for that ruling is easy to understand when you look at a large number of foreign patents, particularly from many of these foreign countries.

Mr. Whitehead: The thing has got to be sufficient to teach what to do, and it doesn't make much difference whether the publication is on one phase or another phase.

Mr. Simpson: I will accept your statement, Mr. Whitehead, that you have to have a clear disclosure in any reference patent of what to do and how to do it or you can't use it as a reference. That is the point that we bring out here. When you take these references here, the foreign references and U. S. patents, you can consider only the
 157 things which they clearly teach you, what to do and how to do it. We claim they do not teach the invention which is claimed in the Doane application.

The Court: When you take two things that are already known but haven't been used together and use them together, is that an invention? For instance, I see automobiles going along the street and they have springs on them; they are patented, no doubt, and they also have, in addition to different kinds of springs, different kinds of tires, balloon tires, and so forth. Now, maybe no automobile maker had ever used a certain type of spring that was known and a certain type of tire that was known in combination, but when he used those together you got a machine that went much more smoothly than any machine before. Could you say that because of that desirable result that was first obtained by using a certain spring or a certain kind of tire, that was an invention?

Mr. Simpson: Your Honor, there are many decisions that say just exactly that, that say you can have patentability in a combination where every single element was known

and was old, and I will cite some authorities on that in the brief.

The Court: I have heard them cited in patent cases for ten years, off and on. You take two things like that, and look at the patent trouble, nobody could use that spring and that tire on the same automobile. Suppose, thinking out loud, nobody else could use a mercury switch breaker
 158 in magnetic testing, in other words, two things that everybody could use before, and they might have used them in conjunction or might not, but from henceforth for seventeen years nobody could use those two things together; that is, granting the patent just on the result.

Mr. Simpson: I think, Your Honor, that this question of whether you can combine these old elements and have a patentable combination—

The Court (Interposing): There you are using a word different from what the Court used.

Mr. Simpson: I was trying to explain that you have one of two situations; either you have an aggregate of elements and you add their functions together and you get nothing new that you didn't have before—

The Court (Interposing): But when you combine those, you are not just using them in conjunction with something else of a larger purpose, such as using the spring and the tire. You are not combining the spring and the tire; you have to keep in mind the bolt that holds the end of the spring, or the way you fasten it onto the body of the automobile. That is a combination.

Mr. Simpson: You can have a combination in an electrical circuit, when you bring different elements of the electrical circuit together and wire them up in a particular way, then you have such a combination as you do in a
 159 machine.

The Court: Suppose you let me have your brief in three days and Mr. Whitehead his reply brief in three days, and I will take the case under advisement.

(Whereupon, at 4:55 p.m., the hearing was adjourned.)

160

Reporter's Certificate

Washington, D. C.

June 19, 1942

I hereby certify that at the time and place aforesaid I reported stenographically the foregoing proceedings and, to the best of my knowledge and belief, this is a true and correct transcript of said proceedings.

FLOY LINN

Subscribed and sworn to before me this nineteenth day of June, 1942.

MARY P. STONE

(Seal)

Notary Public

My commission expires Oct. 1, 1942.

* * * * *

163

Order

Upon application of plaintiff-appellant, defendant-appellee consenting,

It is Hereby Ordered that the original exhibits of plaintiff and defendant filed in this Court and designated by counsel shall be transmitted to the Court of Appeals for the District of Columbia for use on appeal in lieu of copies thereof.

NATHAN F. McGUIRE

Justice

Washington, D. C.

September 2, 1942

Submitted:

THOMAS JAMES MACKAVANAUGH

Attorney for Plaintiff

Consented to:

W. W. COCHRAN

Attorney for Defendant

Washington, D. C.

September 1, 1942

165 *Designation of Contents of Record on Appeal*

Now comes the appellant, Magnaflux Corporation, a corporation, by its attorneys, Charles W. Hills, Jr., and Donald J. Simpson, of 53 West Jackson Boulevard, Chicago, Illinois, and Thomas J. MacKavanagh, Suite 633 Munsey Building, Washington, D. C., under and in accordance with the provisions of Rule 75(a) of the Federal Rules of Civil Procedure, and designates the following as the portions of the record, proceedings and evidence to be contained in the record on appeal:

1. Complaint.
2. Defendant's answer.
3. Appearance of Donald J. Simpson as additional counsel for plaintiff.
4. Findings of fact and conclusions of law entered July 15, 1942.
5. Judgment.
6. Plaintiff's exhibits to be transmitted by the Clerk as physical exhibits:
 - (a) Certified copy of Doane application Serial No. 269,644, Plaintiff's Exhibit 1.
 - (b) Certified copy of Doane application Serial No. 27,756, Plaintiff's Exhibit 2.
 - 166 (c) Photograph, Plaintiff's Exhibit 3.
 - (d) Photograph, Plaintiff's Exhibit 4.
 - (e) Photograph showing what happens when a crack occurs, Plaintiff's Exhibit 5.
 - (f) Photograph, Plaintiff's Exhibit 6.
 - (g) Steel bar used as test piece, Plaintiff's Exhibit 7.
 - (h) Photograph, Plaintiff's Exhibit 8.
 - (i) Chart entitled "Chart Illustrating Difference in Amount of Residual Magnetism with Alternating Current Broken at Different Points of Current Cycle," Plaintiff's Exhibit 9.
 - (j) Chart entitled "Chart Illustrating Demagnetizing Effect of a Damped Break in Alternating Current Energizing Wave," Plaintiff's Exhibit 10.

(k) Chart illustrating Figures 3 and 6 of Doane application Serial No. 269,644, Plaintiff's Exhibit 11.

(l) Chart illustrating drawings of Hauser British Patent No. 379,337, Plaintiff's Exhibit 12.

(m) Chart illustrating drawing of French patent to Van Meyl No. 593,863, Plaintiff's Exhibit 13.

(n) Chart showing equivalent circuit diagrams, of Doane application, of French patent to Van Meyl, and British patent to Hauser, Plaintiff's Exhibit 14.

(o) Transfer of magnetic particles, Plaintiff's Exhibit 15.

(p) Record of test with Scotch transfer of magnetic particles, Plaintiff's Exhibit 15B.

167 (q) Record of tests with Scotch transfers, Plaintiff's Exhibit 16

(r) Record of tests with Scotch transfers, Plaintiff's Exhibit 17.

(s) Record of tests with Scotch transfers, Plaintiff's Exhibit 18.

(t) Record of tests with Scotch transfers, Plaintiff's Exhibit 19.

(u) Tabulation of readings of consecutive magnetizations, Plaintiff's Exhibit 20.

(v) Oscillographic films, Plaintiff's Exhibits 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 and 31.

(w) Blueprints of Plaintiff's Exhibits 21 to 31 inclusive, being Plaintiff's Exhibits 21A, 22A, 23A, 24A, 25A, 26A, 27A, 28A, 29A, 30A and 31A.

(x) Photograph of plaintiff's standard unit type D-363, Plaintiff's Exhibit 32.

(y) Photograph of plaintiff's alternating current machine model KR-3, Plaintiff's Exhibit 33.

(z) Photograph of inspection setup with alternating current machine, Plaintiff's Exhibit 34.

(aa) Photographs showing views of an engine piston, Plaintiff's Exhibits 35 and 36.

7. Defendant's exhibits to be transmitted by the Clerk as physical exhibits:

Folder of prior art patents containing patents to Wilson No. 533,938, Hewitt No. 799,052, Kraus No. 1,046,086, Slepian No. 1,932,090, De Forest No. 2,110,759, Van Meyl, French No. 593,863, and Hauser, British No. 379,337, and also containing print of drawings, Examiner's statement, decision of Board of Appeals, and decision of Board of Appeals on request for reconsideration.

168 8. Notice of appeal filed August 10, 1942.

9. Order fixing appeal bond.

10. Appeal bond.

11. All of the evidence and proceedings at the trial which was stenographically reported, the appellant furnishing herewith two copies of the reporter's transcript of the evidence.

12. A transcript of the docket entries in this action.

13. This designation of contents of record on appeal.

CHARLES W. HILLS, JR.

DONALD J. SIMPSON

53 W. Jackson Blvd.,

Chicago, Illinois.

THOMAS J. MACKAVANAUGH

Suite 633 Munsey Bldg.,

Washington, D. C.

Attorneys for Plaintiff.

Receipt is acknowledged of a copy of the foregoing designation of contents of record on appeal, on this 31st day of August, 1942.

W. W. COCHRAN,

Attorney for Defendant.

* * * * *

169 Endorsed: Filed Sep 2 1942 Charles E. Stewart,
Clerk

Declaration as to Designation

Defendant hereby declares that the Designation of Contents of Record on Appeal filed in the above-entitled cause by attorneys for plaintiff is satisfactory, and that defendant will not object thereto, and will not file any additional designation of record.

W. W. COCHRANE

Attorney for Defendant.

Washington, D. C.

September 1, 1942.

* * * * *

**SUPPLEMENTAL APPENDIX TO BRIEF FOR
APPELLANT.**

IN THE
United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA. DISTRICT OF COLUMBIA

No. 8359.

FILED JAN 5 - 1943

Joseph W. Shannon

CLERK

MAGNAFLUX CORPORATION, a corporation,
Appellant,

v.

CONWAY P. COE, Commissioner of Patents, *Appellee.*

Appeal from the District Court of the United States for the
District of Columbia.

CHARLES W. HILLS, JR.,
DONALD J. SIMPSON,
53 W. Jackson Blvd.,
Chicago, Illinois.
THOMAS J. MACKAVANAGH,
633 Munsey Building,
Washington, D. C.,
Attorneys for Appellant.

INDEX TO SUPPLEMENTAL APPENDIX TO
APPELLANT'S BRIEF.

Page

Foster B. Doane application for patent, Serial No. 269,644	2
Drawing	11
Specification	2
Amendment "C," filed July 13, 1940.....	13
Examiner's Statement on Appeal	15
Decision of Board of Appeals on appeal.....	24
Decision of Board of Appeals on reconsideration.....	27

IN THE
United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA.

No. 8359.

MAGNAFLUX CORPORATION, a corporation,
Appellant,

v.

CONWAY P. COE, Commissioner of Patents, *Appellee.*

Appeal from the District Court of the United States for the
District of Columbia.

**SUPPLEMENTAL APPENDIX TO BRIEF FOR
APPELLANT.**

EXCERPTS FROM APPELLANT'S EXHIBIT NO. 1.

• • • • •

To All Whom It May Concern:

Be It Known that I, FOSTER B. DOANE, a citizen of the United States, and a resident of the City of Wilmette, in the County of Cook, and State of Illinois, have invented certain new and useful improvements in a

“MAGNETIC TESTING METHOD AND MEANS”, and I do hereby declare that the following is a full, clear and exact description of the same, reference being had to the accompanying drawings and to the numerals of reference marked thereon, which form a part of this specification.

The present invention relates in general to a magnetic testing method and means whereby the method may be practiced and is more particularly concerned with such process and means as will enable utilization of cyclic or alternating current for effecting magnetization and a permanently magnetizable object of ferromagnetic material.

The present application constitutes a continuation in part of my co-pending application Serial No. 27,756.

Heretofore, it has been the general practice in the testing of articles of ferromagnetic material to magnetize the article or object being tested and then apply to its surface a finely divided paramagnetic material such as iron filings. In the case of surface defects, these iron filings tend to adhere to the surface in the region of such defects, and due to the discontinuity caused by the surface defects, the crack or other defect is revealed.

For magnetizing the object, it has been the usual practice to utilize direct current. Due to the fact that the use of direct current necessitates the installation of special direct current apparatus, the cost of direct current testing equipment is materially increased. On the other hand,
177 most places where the testing would be carried out are served with alternating current. It will therefore be evident that if alternating current can be satisfac-

torily used for the magnetizing operation of the test object, it is not necessary to go to the additional expense of installing direct current service. Also, the use of alternating current for the magnetization possesses inherent advantages which are not obtained when direct current is used.

In order to enable the utilization of alternating current in magnetic testing of articles of paramagnetic material, it has heretofore been proposed to utilize a polarized relay arranged to operate at a predetermined point of the current cycle and thus assure positive magnetization of the test article. In other words, such a polarized relay was intended to prevent the possibility of interrupting the magnetizing current at a point in its cycle wherein there would be no magnetization left in the test article or object.

While theoretically such a relay would tend to accomplish the desired purpose, practically the use of such a relay would not have the required accuracy to assure positive magnetization of the object being tested under practical conditions and over long periods of use.

Mechanically, such a relay having a pivoted armature is subject to changes which materially affect its time and speed of operation. The pivotal mounting of the armature will not at all times be moved with the same degree of smoothness and forces acting to deter the armature movement by causing a drag on the pivot will vary the speed of operation of the armature. This alone would make the relay unreliable. Moreover, due to the inertia of the moving parts of the relay and the fact that these parts must move some distance before the contacts actually open the circuit,

it is difficult, if not impossible, to secure sufficient
 178 speed of opening of the contacts to confine this opening to a definite point in the current cycle.

The chief difficulty, however, and disadvantage arising from the use of such a relay results from the fact that while the relay contacts may be opened at substantially a predetermined instant, the opening of these contacts does not

effectively control the actual interruption of current flow in the magnetizing current. This is particularly true where the circuit passing through the relay contacts contains inductive reactance, as would be the case where a magnetizing coil is utilized for magnetizing the article being tested. Under such circumstances, the inductive reactance of the circuit will tend to maintain the arc established when the relay contacts are opened and thus enable current flow after opening of the contacts for an indeterminate period of time. It will therefore be apparent that even though the contacts are opened at a predetermined point in the current cycle, the actual interruption of current flow is not directly dependent upon the point in the current cycle at which the contacts are actually separated, but upon other factors in the circuit.

Having in mind the disadvantages and objections to the above as well as other proposed methods of controlling the magnetizing current, the present invention contemplates as a primary object the provision of an improved magnetizing process wherein advantage is taken of the hysteresis effect of the magnetic induction in an object to be tested, and by interrupting the magnetizing current flow at the proper point in the hysteresis curve of the object to positively assure magnetization of the object in a predetermined manner.

It is a further object of the invention to provide an improved magnetizing process utilizing a cyclic magnetizing current, and wherein interruption of the current at a predetermined point in its cycle will be positively assured.

Another object of the present invention is to provide improved means for carrying out the steps of my improved process or method.

Other objects and features of the invention will more fully appear from the following detailed description, taken in connection with the accompanying drawings, which illustrate several arrangements thereof, and in which:

Figure 1 is a graph diagrammatically illustrating a cyclic current such as utilized in connection with the present invention;

Figure 2 is a graph illustrating a typical B/H or hysteresis curve for a test article with which the present invention is utilized;

Figures 3, 4 and 5 are views illustrating several ways in which the present invention may be utilized to magnetize the object under test, these arrangements utilizing a mercury switch for interrupting current flow; and

Figure 6 diagrammatically illustrates the preferred arrangement of apparatus for carrying out the process of the present invention.

AS SHOWN ON THE DRAWINGS:

Referring to Figure 1, there is illustrated an alternating or cycle current such as utilized in the present invention, this graph or curve being indicative of the ordinary alternating current distributed to consumers. In this curve, *a* represents the zero point at the beginning of the current cycle, *b* the maximum positive value of the current at the peak of the cycle, *c* the midpoint of the cycle in which the direction of the current is reversed, *d* the peak or maximum value of current in the reverse direction, and *e* the end of the cycle where the current again starts increasing in a positive direction.

In order that the present invention may be more clearly understood, the relation of this current has been shown in

Figure 2 on a typical hysteresis or B/H curve for the object which is to be magnetized and tested. In

this graphic representation, the changes in *B* or magnetic induction would be indicated by the ordinates, and changes in *H* or the magnetizing force would be represented by the abscissa.

It will be appreciated that when a coil is energized to produce a magnetic field in an object, the amount of magnetization is dependent upon the magnetizing force or the product of the amperes or current times the number of turns in the coil. Moreover, the magnetizing force will

therefore be directly proportional to the amount of magnetizing current flowing in the circuit. If the object to be magnetized is subjected to the magnetizing effect of a cyclic current, such as shown in Figure 1, as the current of the cycle starts at *a*, as shown in Figure 2, the magnetization increases until the point *b* is reached, at which point the object becomes more or less saturated. As the current starts to decrease, after having passed its peak, the magnetic induction does not decrease at the same rate as the current, and it is found that at the reversal or zero point of the current, the test piece would not have its magnetism reduced to zero at this point, but would contain a remanent magnetism corresponding to the amount shown by *a*, *c* in Figure 2. As the current cycle continues, the current starting to increase in the opposite direction, it will be noted from the hysteresis curve that the magnetization continues to lag behind the current and does not reach its point of reversal until after having passed through the zero point or reversal point of the current.

From the foregoing discussion, and as clearly shown on the hysteresis curve, fortuitous opening of the current path to break the current flow by means of a manually operable switch is uncertain, and there is no assurance that the test piece will be left magnetized. That is, there is the ever present possibility that the manually operable switch might

181 interrupt the current flow at the point where the magnetic induction in the test piece is zero or not in the proper direction desired. In attempting to break the current flow at a predetermined point, it is necessary to provide means which must act within a very short interval of time or which, if the interruption of the current continues for more than a half current cycle, must operate to then break the circuit and current flow at the proper point.

In the present invention, where the magnetizing currents are of a relatively small order, it is proposed to use a mercury switch 10 which embodies the usual construction of an envelope 11, through the walls of which project suitable

electrodes 12 and 13. The envelope contains a pool of mercury 14 adapted to bridge the electrodes when the tube is tilted to the position shown in the drawings but interrupt the circuit through the electrodes when the tube is tilted about an axis 15 to a position wherein the mercury flows away from the electrode to the other end of the tube or envelope.

Figures 3, 4 and 5 illustrate several methods in which a test piece may be magnetized from a circuit containing the mercury switch. In Figure 3, a test piece 16 is shown as being surrounded by a coil 17, this coil being connected to a suitable source of alternating current, such as an alternating current generator 18, one side of the circuit to the coil being carried through the electrodes 12 and 13 of the mercury switch. Of course, if desired, the source of alternating current might comprise a step-down transformer connected with a suitable power service.

In Figure 4, the test piece is shown as forming part of a closed magnetic circuit including a laminated soft iron core 19 for the magnetizing coil, this core having pole pieces 20 and 21 for engaging the test piece at spaced points. In the arrangement shown in Figure 5, the test piece is shown as an elongate bar 16b, with the current circuit connected to

the bar so that the current will flow through the bar 182 and thus produce a magnetic field extending circumferentially around the bar. This arrangement for magnetizing the test piece is particularly advantageous in that a skin effect is produced in which the magnetic induction tends to be concentrated at the surface of the article and which may be used most advantageously for indicating surface defects.

One of the characteristics of a mercury switch is that the current is broken at the end of a half cycle or when the current reaches zero value. If the mercury flows away from the electrodes 12 and 13 during a half cycle, the current forms an arc which continues until it is automatically extinguished at the end of the half cycle or zero point, after

which the arc is not again re-established. This characteristic makes a mercury type switch particularly adapted for utilization in my improved process in that fortuitous interruption of current flow is obviated and the current will always be interrupted at a specific point in the current cycle, namely, at a point between the peak value of current and its zero point, and not later than the zero point. The current flow will always be interrupted in this portion of the current cycle, even though the switch itself may be moved to circuit opening position at any time during the current cycle. By interrupting the current flow at a point not later than the zero current point, the object to be tested will be permanently magnetized by magnetic induction which will in no event be less than the amount represented by a , c on the hysteresis curve.

While I have found that the mercury type of switch works very satisfactorily, a different type of switch is desirable, particularly where higher orders of magnetizing current are to be handled. Under such conditions, it is preferred to utilize an arc deionizing type of switch, as generally indicated by the numeral 22 in Figure 6. This type of switch may be used in any of the different arrangements for magnetizing the test object, as shown in Figures 3, 4 and

183 5. Arc deionizing switches are commercially known as Deion contactors.

In general, such a contactor or switch comprises co-operably associated, movable and stationary contacts 23 and 24 which are disposed in the lowermost end of a hollow arcing box 25, this box defining a deionizing chamber 26 having its uppermost end open. The uppermost end of the deionizing chamber above the contacts contains a plurality of vertically disposed, slotted metal plates 27 which form the deionizing grids. These plates are ordinarily made of copper but may be made of iron or other material with satisfactory results.

As a part of the construction, there is provided a yoke 28 of iron, this yoke being U-shaped and providing laterally

disposed wing portions 29 on opposite sides of the arcing box in straddling relation to the switch contacts. Flow of current through the contacts produces a magnetomotive force across the air-gap and through the iron yoke equivalent to one turn. When the contacts are opened, an arc is established and the local field around the arc reacts with the main field across the air-gap to cause a blowing in or upward movement of the arc into the deionizing chamber. In general, the arc does not go very far into the deionizing grids before the end of the current cycle, at which time the deionizing action takes place and the arc is prevented from re-igniting. If the current is large and the motion of the arc is such that the end of a half cycle does not come until after separate arcs are formed between the grids, deionization at the surface of a solid becomes active. In this case, immediately after the current passes through zero, the space adjacent to the cathode of each short arc acquires either a space charge or a thin deionized layer and is capable of withstanding considerable voltage without re-igniting.

For very low current, re-ignition may occur at several reversals of current until the position of the arc with respect to the deionizing grids is satisfactory for extinction, at which time the arc will be extinguished at current zero and re-ignition prevented. The deionization or restoration of insulating properties to the entire arc path is much faster in this type of switch than in the case where the arc is drawn in open air.

From the foregoing description, it will be apparent that the present invention provides an improved process and means for carrying out the steps of this process for permanently magnetizing objects of paramagnetic material during testing operations, the magnetization being accomplished by the use of alternating current; and wherein the interruption of the magnetizing current at a predetermined point in its current cycle will be positively assured; and which takes advantage of the hysteresis effect of the magnetic induction in the object to be magnetized by interrupt-

ing the magnetizing current at the proper point in the hysteresis curve of the object to positively assure magnetization of the object in a predetermined manner.

While I have specifically illustrated and described my process and preferred means for carrying out the steps of the process, it is to be understood that the invention is not to be so limited, but may be otherwise embodied and practiced within the scope of the following claims.

* * * * *

Fig. 1

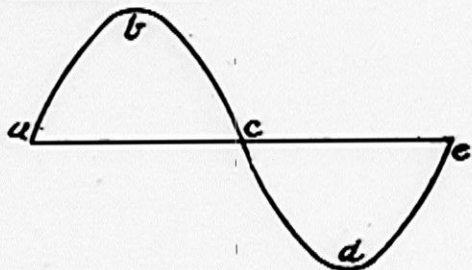


Fig. 3

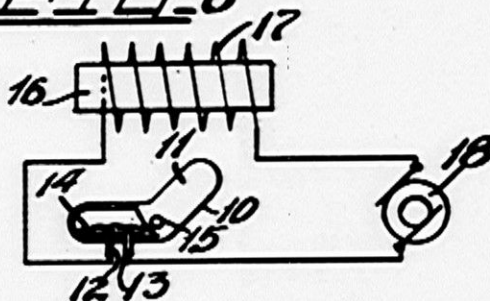


Fig. 4

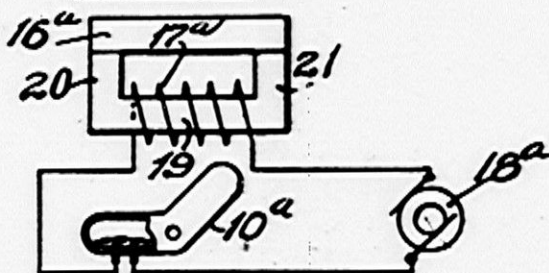


Fig. 5

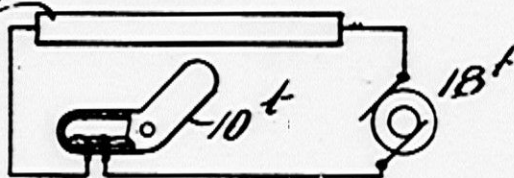


Fig. 2

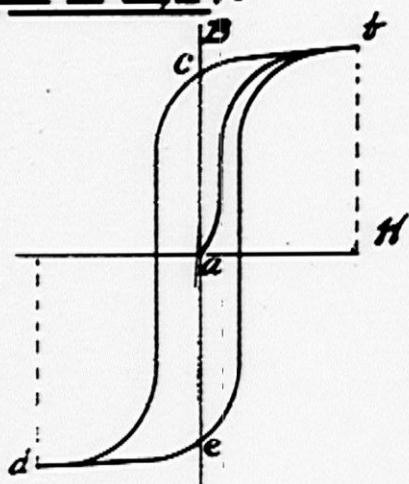
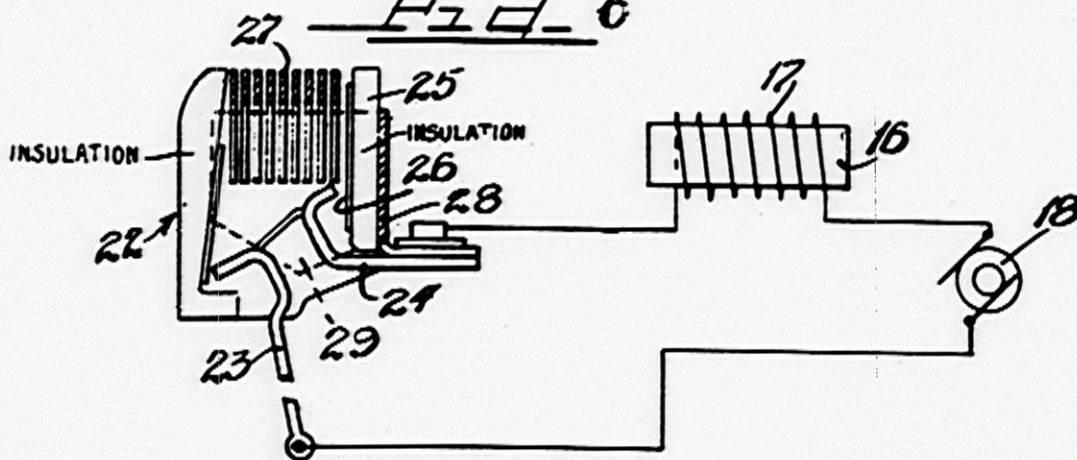


Fig. 6



INVENTOR
Foster B. Doane

Charles M. Hill
Attys

206 Endorsed: Application Div. U. S. Patent Office
Jul 13 '40.

Jul 13 1940 Division 48

Paper No. 7
Amendment C

Supplemental Amendment
(Amendment "C")

Division 48
Room 5731

Washington, D. C.
July 12, 1940

Hon. Commissioner of Patents
Washington, D. C.

Sir:

In re application: Foster B. Doane

Magnetic Testing Method and Means
Serial No. 269,644
Filed April 24, 1939

In further response to the Office action of January 13, 1940, and supplementing Amendment "B" filed July 5, 1940, applicant hereby amends as follows:

Please substitute the following claims for claims 14 to 16:

—17. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero, and to then interrupt said circuit.

207 —18. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero and to then interrupt said circuit, said switch means comprising mercury confined within an envelope.

—19. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero, and to then interrupt said circuit, said switch means comprising means to form an ionized vapor and electromagnetic means to de-ionize said vapor.—

• • • • • • • • •

Mailed Aug 9 1940

Department of Commerce
United States Patent Office
Washington

Before the Board of Appeals on Appeal

In re application of Foster B. Doane, Serial No. 269,644,
Filed April 24, 1939, Magnetic Testing Method and
Means Charles W. Hills, 1414 Monadnock Block, Chi-
cago, Ills.

Examiner's Statement

Applicant appeals from the final rejection of claims 17, 18, and 19, substituted by permission for finally rejected claims 1 to 13, and constituting the only claims remaining in the case. These are as follows:

17. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero, and to then interrupt said circuit.

18. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to nor-

mally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero and to then interrupt said circuit, said switch means comprising mercury confined within an envelope.

19. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero, and to then interrupt said circuit, said switch means comprising means to form an ionized vapor and electromagnetic means to de-ionize said vapor.

References relied upon:

Van Meyl (Fr)	593,863	June 6, 1925,
Hauser (Br)	379,337	Aug. 26, 1932,
Wilson	533,938	Feb. 12, 1895,
Hewitt	799,052	Sep. 12, 1905,
Kraus	1,046,086	Dec. 3, 1912,
Slepian	1,932,090	Oct. 24, 1933,
De Forest	2,110,759	Mar. 8, 1938.

Applicant's Disclosure:

Applicant discloses and claims means for magnetizing magnetic articles by use of alternating current. Any of various common magnetizing circuits may be used (Figs. 3, 4, 5). The alleged novelty lies in the use of certain specific circuit-interrupting means in such circuits.

To magnetize an article of magnetic material, it is necessary to apply a magnetic field to the article. Upon withdrawal of this field, the article is found to possess a residual magnetism of its own. If, however, an increasing field should now be applied in the opposite direction, the residual magnetism would first be reduced to zero, and
 214 then established in the opposite direction, the amount of reversed residual magnetism depending upon the size of the reversed field.

When a direct current is used to magnetize, the possibility of reversal does not arise. When alternating current is used however, the article is magnetized alternately in opposite directions so long as current flow continues, the amount of residual magnetism remaining in the article depending upon the point in the cycle at which the current is broken.

Applicant's Fig. 2 shows this characteristic in the diagram form of a typical hysteresis curve. The values of magnetic field, which are proportional to current, (see page 5, lines 9-11) are measured along the horizontal axis. The values of residual magnetism are measured along the vertical axis. When the current (hence field) is increasing, the residual magnetism increases, along the curve a-b. If the current is interrupted at or just after the moment when it reaches its maximum, the field thereupon decreases to zero, and the flux drops back along the curve b-c, the distance a-c representing the residual flux or magnetism. This is true if the current is interrupted *at any time* between the moment when the current is a maximum, and the first subsequent moment when the current cycle would if uninterrupted pass through zero (see specification, page 7, lines 13-19). If however, the current should not be interrupted

until after the zero point, its direction would reverse, and the residual magnetism would first diminish and then reverse, along the curve c-d. The next half of the current cycle, along the curve d-e-b, duplicates the curve b-c-d, in reversed direction. It is evident from this diagram that for maximum magnetizing by alternating current, the current must be interrupted during the decreasing portion of any current half cycle, not later than the zero point.

215 Applicant's device insures this by using an arc as the current interrupting device. The arc is established by separating two metal electrodes originally in contact. At separation, an arc is formed, establishing an ionized path for the current, the arc persisting as long as ionized vapor exists to form a conducting path and voltage is high enough to overcome the relatively low resistance of an arc path. The ionized substance in one form of applicant's device is mercury vapor, and in another form is air (Deion form).

As the current during any half cycle diminishes, the voltage drop available becomes less than the voltage necessary to sustain the arc, and the arc goes out. De-ionization thereupon occurs. If it is complete before the re-strike voltage rises to an effective value, the arc does not restrike. If enough ionization still exists to permit re-striking of the arc, current flows for another half cycle, and again the arc goes out as the current approaches zero. When ionization has finally fallen below the point at which re-striking can occur, the arc remains out, and the current is stopped (see end of page 7). It is evident therefore that whenever an arc occurs between separated contacts and the contacts are not separated so far and so fast as to interrupt the arc immediately, the arc and hence the current will persist after contact separation until the zero point of the first or an early half cycle is nearly reached, and then go out.

An arc therefore ideally fulfils the requirement for A. C. magnetization, in interrupting the current always at a point in a cycle where the current has passed its peak, but has not yet fallen to zero.

Applicant discloses two forms of arc-establishing means. One, a mercury switch, was disclosed in application Serial No. 27,756, filed June 19, 1935, of which this case is a continuation-in-part. The other, a "Deion contactor" of known structure, is disclosed in this application for the first time used in applicant's device, especially where the magnetizing current is large. No details of these circuit-breaking devices from which exact characteristics might be determined are disclosed. Nothing is described as to vapor pressure within the mercury interruptor, contact separation distance on open circuit, presence of gas within the interruptor, etc. The disclosure must therefore be considered as teaching nothing more than the broad concept of an arc-type circuit breaker, of the mercury or Deion type, used as the contact-breaker in an A.C. magnetizing device.

Reference Disclosures:

Van Meyl (French) 593,863 discloses a similar device for magnetizing articles by use of alternating current. An A.C. source is connected through an "automatic interrupter" to a magnetizing circuit. Such an interrupter may be a fuse, or other suitable form of interrupter "as for example an electro-magnetic interrupter" if it is desired to "avoid the replacement of fuses." When the push button 6 closes the magnetizing circuit, a heavy current flows through the magnetizing circuit including the fuse, which "it seems always interrupts the current when the field intensity is near its maximum" (page 2, lines 25-32). The Van Meyl reference does not explain why this is true. As is well known however, a fuse interrupter first melts, then separates, forming an arc as it separates, and opens the circuit when the arc goes out. The fuse therefore interrupts the current between the maximum value and the following zero point of any given half cycle, the exact moment of extinction depending, as in applicant's case, on the undisclosed specific characteristics of the specific interrupter used. While other interrupters are not described in de-

tail, it is presumable that any usual type interrupter affording the same result, such as the common electro-magnetic mercury switches of the references below, is intended. Houser (British) 379,337 discloses another alternating current magnetizing apparatus, opening the circuit at contacts 11-12 in such a way that "the interruption of the alternating current traversing the magnetizing coils is effected at the crest of the alternating current phase, or immediately after the same." When contacts in a magnetizing circuit are opened, arcing at the contacts normally follows; and where, as in Houser, the contacts are separated only a very short distance, this arc will normally persist until the current approaches the zero.

Wilson 533,938; Hewitt, 799,052, and Kraus, 1,046,086.

These three references are typical of an extensive art of electromagnetic interrupters using mercury as the circuit interrupting means. That the utility of a mercury switch in interrupting near the zero point of the current cycle is well known is exemplified by Hewitt at page 2, lines 24-41, and Kraus at page 2, lines 34-38. Hewitt also teaches the use of a magnetic blow-out for the arc (page 2, lines 119 to page 3, line 36).

Slepian 1,932,090 discloses the "Deion contractor" used by applicant as interrupter in one form of his device, describes it as especially designed to handle large currents, and uses a magnetic blow-out for the arc formed when contacts are separated.

De Forest 2,110,759 discloses the same type of magnetizing device as applicant, the circuit-breaker consisting of contacts forming an arc when they separate.

The circuit-breaker may be a mercury switch. However, "other forms of switches", such as "a switch having contacts made of some relatively fusible metal, such as brass or copper, and which has a not too fast separation of the contacts, will break the current at substantially the end of a half current cycle. The readily fusible metal forms a metallic arc, and if the contacts are separated relatively

slowly, such arc persists until the end of the half current cycle."

This reference is not available against the generic and mercury switch species claims in this case, as the subject matter of these claims was present in the case Serial No. 27,756 referred to above, antedating the De Forest application Serial No. 32,165. It is available, however, against the claim defining electromagnetic de-ionizing means, since that means is new in this case.

Basis of Rejection:

Present claims 17, 18, and 19 were substituted by permission for finally rejected claims 1 to 13.

As these claims are more specific than the claims which they replace, a more specific application of the reference art is necessary.

Claim 17 is generic to both species of applicant's invention. Claim 18 is specific to the mercury switch species. Claim 19 is specific to the "Deion" species.

Referring now to generic claim 17, and to basic references Houser and Van Meyl, it is obvious that the structure of the first five lines of the claim is shown by both references. The only arguable distinction lies in the definition of the "switch means" found in lines 6 to 15. In

Hauser and Van Meyl, the switch is arranged to open
 219 automatically soon after the circuit is closed, while applicant's means is "arranged to normally remain closed for a period of time which is independent of the sign of the current wave". It should be noted first that the disclosure has nothing to say about how long the switch is closed, or whether it is opened automatically soon after closure. Hence, such language is admissible only on the basis that such switch means is well known. The language simply means that the switch may remain closed awhile if desired. No advantage of such closure is apparent. The distinction here defined appears nothing more than an obvious equivalent of the automatic interrupters of Hauser, and Van Meyl, without utility or benefit, and constituting

rather a disadvantage, by loss of energy and time, than an advantage.

The claim also specifies the switch means as "independent of the heating effect of the current in the switch." It is questionable whether this is true of applicant's device, which depends upon an arc, an arc being entirely dependent upon a "heating effect". In any sense in which it can be considered true of applicant's device, it is equally true of the Hauser device, and of the Van Meyl device when an "electromagnetic interrupter" is substituted according to Van Meyl's teaching for the fuse interrupter.

The claim also defines the switch means as movable at a defined time (in fact, it is movable at any time, with no disclosed preference in time) "to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero, and to then interrupt said circuit." As explained previously in this statement, it is characteristic that any arc is finally extinguished near the point in any half cycle where the current is approaching zero.

220 Since there is an arc formed in the Hauser device (see page 3, lines 11 to 15 of applicant's specification for agreement with this), the current may continue to flow "for an indeterminate period of time", as indeed it may in mercury switches, but will finally go out, as in applicant's device, at a moment in some cycle when the current is dropping to zero. (See specification, page 8, last three lines). De Forest confirms this fact. The arc formed by the fusible metal of Van Meyl will also go out at this point; and the arc formed between contacts of the Van Meyl equivalent "electromagnet interrupter" will also go out at this point, whether the arc arises in the mercury vapor of the commonly used mercury switches (Wilson, Hewitt, Kraus), or in the ionized path of other contact metal (see De Forest statement).

It appears clear therefore that nothing in claim 17 defines any useful patentable distinction over the Hauser or Van Meyl device.

Claim 18 adds, "said switch means comprising mercury confined within an envelope". Since "mercury confined within an envelope" is one of the most widely known forms of the "electromagnetic interrupter" named by Van Meyl, (see Wilson, Kraus, Hewitt) its use in place of the Van Meyl fuse is held clearly within the teaching of Van Meyl.

Claim 19 adds "electromagnet means to de-ionize said vapor". As such means are known for both mercury switches (Hewitt) and "Deion" switches (Slepian), this feature adds nothing patentable to claim 17. It should be noted here that claim 19, defining a feature not present in the earlier application, appears unpatentable over the De Forest reference, as well as over other art of record, in view of the magnetic deionizing means of Hewitt and Slepian.

221 In summary, it appears that none of claims 17, 18, and 19 defines any useful patentable distinction over the teaching of the reference art. The final rejection should therefore be affirmed.

Respectfully submitted,

OTTO B. ROPKE

Examiner, Division 48.

HBW:P

* * * * *

238

Before the Board of Appeals

Appeal 33915

Hearing Jan. 23, 1941

Ex parte Foster B. Doane

Application for Patent filed April 24, 1939, Serial No. 269,644. Magnetic Testing Method and Means.

Mr. Charles W. Hills for applicant.

This is an appeal from the action of the examiner finally rejecting claims 17, 18 and 19.

Claim 17 will serve as illustrative.

17. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero, and to then interrupt said circuit.

The references relied upon are:

	Wilson,	533,938,	Feb. 12, 1895,
239	Hewitt,	799,052,	Sept. 12, 1905,
	Kraus,	1,046,086,	Dec. 3, 1912,
	Van Meyl, (Fr.),	593,863,	June 6, 1925,
	Hauser, (Br.),	379,337,	Aug. 26, 1932,
	Slepian,	1,932,090,	Oct. 24, 1933,
	De Forest,	2,110,759,	Mar. 8, 1938.

The claims on appeal are directed to a system intended to be used in magnetizing a steel specimen. The alleged

novelty of the system resides in the use of a specific type of switch for opening the magnetizing circuit. Appellant desires to open this circuit at or about the point of zero voltage to insure, because of current lag, a comparatively high degree of magnetizing flux in the specimen at the time the circuit is broken. To open the circuit at the point of substantially zero, appellant may alternatively employ a switch of either the mercury type or one of the more modern deionizing type capable of handling a much heavier flow of current. In the specification as filed, page 7, beginning with the first full paragraph, it is stated, "One of the characteristics of a mercury switch is that the current is broken at the end of a half cycle or when the current reaches zero value". If it was known in the art that it was desirable to open the circuit when the current reached zero value, we are unable to see that appellant made an invention in utilizing the well known characteristics of a mercury switch to attain that result.

In the British patent to Hauser it is stated:

"With a hand operated switch it is obviously impossible to effect with any certainty the interruption at the right moment of the alternating current traversing the magnetizing coils. But even interruption at the neutral point, as already proposed for the primary circuit of a transformer fed with alternating current, which could also be used as a magnetizing apparatus, merely ensures the interruption at a moment at which the field of the secondary winding possesses its maximum strength, but not the attainment of the desired polarity in the object to be magnetized."

240 It seems to us that the above-quoted matter shows a full appreciation by the prior art of the desirability of interrupting the circuit at the zero point. The patentee here sought to improve on prior practice by determination of the particular phase when the opening occurred by the use of a polarizing relay. Appellant seems to have the im-

pression that there is no way of determining in the Hauser patent how much magnetization will be given the specimen prior to the opening of the magnetizing circuit. From the brief, appellant seems to be of the opinion that the switch 5 is utilized to close the magnetizing circuit. Such is obviously not the case. Switch 5 is placed in a control shunt from the main circuit which is utilized to determine the time of opening of the switch 11, 12 which is in the main circuit, apparently along with some other switch in the main leads to the left of the actual showing. This is borne out by the paragraph beginning in line 90, page 1. In using the Hauser apparatus, the magnetizing circuit through leads 13 and 14 might be closed and left in operative condition for any desired length of time sufficient to obtain saturation of the specimen before the closing of the switch 5 to break the circuit. Upon closing of the switch 5, the circuit would apparently be broken at or about the neutral point of the current wave through the shunt and hence the desirable results of appellant's procedure obtained.

We see nothing inventive in substituting for the relay circuit opener of this patent a mercury vapor switch or one of the more modern deionizing type, such as shown in Slepian, especially as the use of switches of other
 241 types is suggested in the French patent as a substitute for a fusible link. If the examiner's theory as to the circuit breaking characteristics of an ordinary fuse is correct and appellant has not controverted the examiner's statement with respect to this matter, a mercury vapor switch would be no more than an obvious equivalent of a fuse.

The De Forest patent, which the examiner admits is too recent to be effective against claims 17 and 18, clearly discloses a system substantially the same as appellant's and also sets forth as one of the characteristics of a mercury switch that the current is broken at the end of a half cycle when the current reaches zero value. This patent also sug-

gests the use of other forms of switches in place of the mercury switch.

The examiner's action is affirmed.

BOARD OF APPEALS

P. P. PIERCE

Examiner-in-Chief

E. T. MORGAN

Examiner-in-Chief

F. J. PORTER

Examiner-in-Chief

February 12, 1941

Mr. Charles W. Hills,
1414 Monadnock Block,
Chicago, Ill.

* * * * *

249 Before the Board of Appeals

Ex parte Foster B. Doane

Application for Patent filed April 24, 1939, Serial No. 269,644. Magnetic Testing Method and Means.

Mr. Charles W. Hills for applicant.

On Request for Reconsideration

Reconsideration is requested of the decision rendered by us on February 12, 1941, in which we affirmed the action of the Primary Examiner in rejecting the claims on appeal.

In the petition for reconsideration, petitioner emphasizes the fact that the Hauser patent states that it is obviously impossible, with a hand-operated switch, to effect the opening of the magnetizing circuit with any certainty at the right moment. The fact that Hauser proposes to open the circuit at the crest of the alternating current wave, whereas
250 appellant proposes to open the circuit at the zero point of such wave, is also emphasized. As we understand the matter, there is no particular objection

to opening the circuit at the crest of the wave if this can be expeditiously accomplished. Appellant's expedient of opening the circuit at the zero point is no way superior, in so far as results are concerned, but his is an expedient which can be utilized without any substantial sacrifice of efficiency. It is because of this that appellant is enabled to use a circuit closer which opens the circuit at the zero point of the current wave rather than its crest. If appellant were the first to recognize that a magnetizing circuit could be opened at the zero point without sacrifice of magnetizing efficiency, there might be some element of patentability in the subject matter appealed. It was for the purpose of showing that appellant was not the first to recognize this that we called specific attention to the Hauser patent.

It is our view that Hauser, in referring to the impossibility of accomplishing the desired interruption with a hand switch, used the expression "a hand-operated switch" in the same sense that appellant used it in the last paragraph, page 5 of his specification, where he makes a statement quite similar to that made by Hauser. Obviously, both Hauser and appellant were referring to circuit interrupters of the ordinary mechanical type such as a knife-blade switch, for instance. We are still of the opinion that, inasmuch as the art was aware of the fact that mercury-type switches in operation tend to break the current at the end of a
 251 half cycle and was also aware of the fact that in magnetizing operations it was feasible to break the magnetizing current at this point, the use of such a switch for such a type of current interruption involved no element of inventiveness.

We were apparently in error in stating that appellant had not controverted the examiner's statement with respect to the circuit-breaking characteristics of an ordinary fuse. We now recall that appellant did urge, in his original brief, that the interruption of a circuit by a fuse was a function of current squared times time. We feel, however, that this

contention does not disprove the position taken by the Primary Examiner for, as we understand the matter, the rule referred to applies to the melting of the fusible conductor, and not necessarily to the actual circuit interruption which might obviously be continued, as stated by the examiner, through arcing between the unmolten portions of the conductor.

We have reconsidered our former holding in view of the contentions made in the petition without coming to any different conclusion than that heretofore stated.

The examiner's action is therefore again affirmed for the reasons herein and heretofore given.

BOARD OF APPEALS

P. P. PIERCE

Examiner-in-Chief

E. T. MORGAN

Examiner-in-Chief

F. J. PORTER

Examiner-in-Chief

March 19, 1941

* * * * *

BRIEF FOR APPELLEE

**In the United States Court of Appeals
for the District of Columbia**

APPEAL NO. 8359

MAGNAFLUX CORPORATION, APPELLANT

v.

CONWAY P. COE, COMMISSIONER OF PATENTS, APPELLEE

**APPEAL FROM THE JUDGMENT OF THE DISTRICT COURT OF
THE UNITED STATES FOR THE DISTRICT OF COLUMBIA**

W. W. COCHRAN,

Solicitor, United States Patent Office,

Washington, D. C.,

Attorney for Appellee.

R. F. WHITEHEAD,

Of Counsel.

INDEX

	Page
Introduction.....	1
Statement.....	1
Summary of argument.....	2
Argument.....	3
Conclusion.....	10
Authorities cited:	
<i>Altoona Publix Theatres v. American Tri-Ergon Corp.</i> , 294 U. S. 477.....	9
<i>Cuno Engineering Co. v. Automatic Devices Corp.</i> 314 U. S. 84, 534 O. G. 699.....	6
<i>Electrons, Inc., et al., v. Coe</i> , 69 App. D. C. 181, 99 F. (2d) 414, 1938 C. D. 72.....	8
<i>Minnesota Mining & Manufacturing Co. v. Coe</i> , 73 App. D. C. 146, 118 F. (2d) 593, 1941 C. D. 79.....	10
<i>Morrison v. Coe</i> , 74 App. D. C. 335, 122 F. (2d) 793, 1941 C. D. 75.....	9
<i>Newcomb David Co. v. R. C. Mahon</i> , 59 F. (2d) 899, 1932 C. D. 553.....	7
<i>Wolf, et al., v. Coe</i> , 72 App. D. C. 224, 112 F. (2d) 857, 1940 C. D. 27.....	9

(I)

**In the United States Court of Appeals
for the District of Columbia**

APPEAL NO. 8359

MAGNAFLUX CORPORATION, APPELLE

v.

CONWAY P. COE, COMMISSIONER OF PATENTS, APPELLEE

***APPEAL FROM THE JUDGMENT OF THE DISTRICT COURT OF THE
UNITED STATES FOR THE DISTRICT OF COLUMBIA***

BRIEF FOR THE COMMISSIONER OF PATENTS

INTRODUCTION

This is an appeal from the judgment (Appendix 12) of the District Court of the United States for the District of Columbia dismissing a complaint (Appendix 1 et seq.) in which appellant sought to have the Court determine that the plaintiff is entitled to a patent on the application of Foster B. Doane, filed April 24, 1939, and given Serial No. 269,644, which was assigned to the plaintiff, containing claims 17, 18 and 19.

STATEMENT

The application of Doane involved herein is entitled "Magnetic Testing Method and Means" and it was filed as a continuation-in-part of an earlier Doane application, Serial No. 27,756, filed June 21, 1925, which was entitled "Process of Magnetizing."

The application describes the process of magnetizing ferromagnetic articles which are to be tested to determine whether flaws exist therein by the well-known magnetic testing method.

This latter method consists in applying finely divided paramagnetic material, such as iron filings, to the surface of the magnetized article. If any defects exist on the surface, or below the surface, the filings will adhere thereto in the region of the defects. The applicant proposes to use an alternating current of electricity for causing the magnetization. It is further proposed to place in the electric circuit a switch, which when opened, will cause the alternating current to be interrupted at its zero point, which will insure a maximum magnetization of the article. The application states that the switch to be used may be a mercury switch or, under certain conditions, a de-ionizing switch, each of which has the characteristic that it will cause the alternating current to be broken at its zero point.

The claims were refused by the Patent Office in view of the following patents:

Wilson, 533,938, Feb. 12, 1895.

Hewitt, 799,052, Sept. 12, 1905.

Kraus, 1,046,086, Dec. 3, 1912.

Slepian, 1,932,090, Oct. 24, 1933.

de Forest, 2,110,759, Mar. 8, 1938.

Van Meyl (Fr.), 593,863, June 6, 1925.

Hauser (Br.), 379,337, Aug. 26, 1932.

The District Court in its findings of fact (Appendix 9) stated that the claims on appeal define no invention over either the French patent to Van Meyl or the British patent to Hauser, in view of the prior art, as exemplified in the other patents cited.

SUMMARY OF ARGUMENT

I. The British patent to Hauser shows that it was well known, prior to any date of invention claimed by the applicant Doane, that, if when alternating current is used as a magnetizing current and that current is broken at its zero point, the magnetization of the article will be at its maximum value; and, it was well known that if a mercury switch or a de-ionizing switch is placed in an alternating circuit, the current, when the switch is open, will be interrupted at its zero point.

II. That in view of this knowledge there would be no invention in substituting for the fuse of the French patent to

Van Meyl, or for the polarized relay controlled switch of the Hauser patent, a mercury switch or a de-ionizing switch.

III. Claim 19 is not patentable over the de Forest patent in view of the Slepian patent which discloses a de-ionizing switch.

ARGUMENT

I. The British patent to Hauser describes means for magnetizing articles using an alternating current, the apparatus being so arranged that the desired polarity of the magnetized article can be obtained.

In the first paragraph of the specification of that patent it is said:

This invention relates to a magnetizing apparatus for operation with alternating current. In magnetizing devices the coils of which for the generation of the magnetizing field are supplied with alternating current it has hitherto proved a matter of difficulty in the first place to utilize the greatest strength of the alternating field for the magnetizing process, and secondly to determine in advance the polarity of the object to be magnetized.

It is then further said:

With a hand operated switch it is obviously impossible to effect with any certainty the interruption at the right moment of the alternating current traversing the magnetizing coils. But even interruption at the neutral point, as already proposed for the primary circuit of a transformer fed with alternating current, which could also be used as a magnetizing apparatus, merely ensures the interruption at a moment at which the field of the secondary winding possesses its maximum strength, but not the attainment of the desired polarity in the object to be magnetized.

It was admitted by the witness, Clarke (Appendix 81), that the "neutral point" referred to in the above quotation means the "zero point" of the alternating current.

It thus appears that this patent fully discloses that interrupting the alternating current at its zero point will give a max-

imum magnetization of the article being magnetized, and it is further said in the patent that this will not insure the attainment of the desired polarity in the article and, therefore, the arrangement shown and described in the patent is used so as to obtain that result. It appears that in the apparatus of the Hauser patent the controlling switch for opening the alternating current is placed in a circuit in shunt to the main alternating circuit, and that this switch is caused to be opened by a polarized relay.

As stated above, the use of the apparatus described in the patent is made, rather than the breaking of the circuit at its zero point, because Hauser wished to insure the proper polarity of the article magnetized.

It cannot be doubted that anyone skilled in the art reading the Hauser patent would know that an article which was being magnetized, by using an alternating current, would have its maximum magnetization when the current was interrupted at its zero point.

The patents to Wilson, Hewitt, and Kraus all show mercury switches and the Kraus patent discloses that a characteristic of a mercury switch is that it will cause the alternating current to be broken at the zero point.

The Doane application states (page 7):

One of the characteristics of a mercury switch is that the current is broken at the end of a half cycle or when the current reaches zero value.

II. There are three claims in suit, of which claim 17 reads as follows:

17. In combination, a steel specimen to be permanently magnetized, a source of alternating current of reversible flow sign, a circuit connecting said source with said specimen to magnetize the specimen, and switch means in series circuit association in said circuit, said switch means being movable to close said circuit and being arranged to normally remain closed for a period of time which is independent of the sign of the current wave and also independent of the heating effect of the current in the switch, said switch means

being also arranged movable to circuit-interrupting position while the circuit voltage is of a varying but substantial value of a selected one sign to establish an arc in said switch and to thereby automatically maintain the circuit in closed condition for current flow of said one sign until the current wave reaches a value of substantially zero, and to then interrupt said circuit.

It will be noted that the claim is stated in the form of a combination consisting of, (a) a steel specimen to be permanently magnetized, (b) a source of alternating current, (c) a circuit connecting the source with the specimen, and, (d) switch means which is further characterized by certain functions thereof, including the statement that the switch maintains the current in closed condition until the current wave reaches a value of substantially zero when the circuit is interrupted.

Claims 18 and 19, respectively, add to claim 17 that the switch means comprises "mercury confined in an envelope" and that it comprises "means to form an ionized vapor and electro-magnetic means to de-ionize said vapor".

In determining whether the above claims define an invention it is desirable to set out what was known prior to Doane's work.

Testing steel articles for flaws by magnetizing them and sprinkling para-magnetic particles thereover was, as admitted in the Doane application, well known.

It was also known that articles could be magnetized by an alternating current of electricity, as is shown by the French patent to Van Meyl and the British patent to Hauser of record.

It was also known that interrupting the magnetizing alternating current at its zero point would insure a maximum magnetization in the articles being magnetized, as described in the Hauser patent. This, of course, would insure similar magnetization in every one of the articles magnetized.

It was known that a mercury switch in an alternating circuit would cause the current to be broken at the zero point. This is shown by the patents above cited and admitted in the applicant's application, and also on page 12 of the brief.

With this knowledge, was there any invention in substituting a switch having these known characteristics for the switch used either by Van Meyl or Hauser for interrupting the circuit? Was not the making of such a substitution simply following the teachings of the art?

In other words, the British patent having made it plain that, if the alternating current which is used in magnetizing steel articles is interrupted at its zero point, the magnetization of the article will be at a maximum, it was not invention to use a switch having the characteristics above indicated of breaking the current at the zero point, in lieu of the switch shown in the Hauser circuit. Nor, for the same reason, was it invention to use such a switch in lieu of the fuse of the French patent to Van Meyl, especially as that patent stated that an electromagnetic circuit breaker can be used in lieu of the fuses.

No one has, as yet, given an exact definition of what an invention is, except by a process of exclusion, that is, by setting out what is not an invention, but surely it cannot be invention where one has only followed the teachings of the prior art.

In appellant's brief it is twice stated that the claims were not rejected on a single reference. But, what of it? Anticipation, which means lack of novelty, is not the only ground for refusing a patent. To justify the grant of a patent, not only must usefulness and novelty exist, but invention must also exist.

The Supreme Court of the United States has comparatively recently emphasized the necessity of invention before a patent can be issued, and in its decision in *Cuno Engineering Co. v. Automatic Devices Corp.*, 314 U. S. 84, 534 O. G. 699, that Court said:

We may concede that the functions performed by Mead's combination were new and useful. But that does not necessarily make the device patentable. Under the statute (35 U. S. C., sec. 31; R. S. 4886) the device must not only be "new and useful," it must also be an "invention" or "discovery." *Thompson v. Boisselier*, 114 U. S. 1, 11. Since *Hotchkiss v. Greenwood*, 11 How.

248, 267, decided in 1851, it has been recognized that if an improvement is to obtain the privileged position of a patent more ingenuity must be involved than the work of a mechanic skilled in the art. *Hicks v. Kelsey*, 18 Wall. 670; *Slawson v. Grand Street R. R. Co.*, 17 Otto 649; *Phillips v. Detroit*, 111 U. S. 244; *Saranac Automatic Machine Corp. v. Wirebounds Patents Co.*, 282 U. S. 704 (8 U. S. P. Q. 115); *Honolulu Oil Corp. v. Halliburton*, 306 U. S. 550 (41 U. S. P. Q. 177). "Perfection of workmanship, however much it may increase the convenience, extend the use, or diminish expense, is not patentable." *Reckendorfer v. Faber*, 2 Otto 347, 356-357. The principle of the *Hotchkiss* case applies to the adaptation or combination of old or well-known devices for new uses. *Phillips v. Detroit*, *supra*; *Concrete Appliances Co. v. Gomery*, *supra*; *Powers-Kennedy Contracting Corp. v. Concrete Mixing & Conveying Co.*, *supra*; *Electric Cable Joint Co. v. Brooklyn Edison Co.*, 292 U. S. 69 (21 U. S. P. Q. 1); *Altoona Publix Theaters, Inc., v. American Tri-Ergon Corp.*, *supra*; *Textile Machine Works v. Louis Hirsch Textile Machines, Inc.*, 302 U. S. 490 (36 U. S. P. Q. 37); *Toledo Pressed Steel Co. v. Standard Parts, Inc.*, 307 U. S. 350 (41 U. S. P. Q. 593). That is to say the new device, however useful it may be, must reveal the flash of creative genius, not merely the skill of the calling. If it fails, it has not established its right to a private grant on the public domain.

Appellant also urges that the claims cover a novel combination of elements and from that premise seems to draw the conclusion that it necessarily follows that the claims are patentable. That premise, however, does not support the conclusion. It is well settled that a combination claim may be patentable even if all the elements are old, but that such claims are not patentable unless invention is shown.

This is clearly stated in the decision in *Newcomb David Co. v. R. C. Mahon* (C. C. A. 6), 59 F. (2d) 899, 1932 C. D. 553, where the Court said:

It is elementary that invention may reside in a combination of elements all of which were theretofore separately old in the art, but, in order to sustain such a combination, it is equally clear that the inventor must have done more than make a judicious selection from the devices of the prior art, each designed and utilized to accomplish its individual purpose at a time and in a place where such function is necessary for the operation of the whole. This is but the exercise of the mechanical ability reasonably to be expected in the development of the art, and has repeatedly been held insufficient to evidence invention, whether such decision be placed upon the ground of aggregation or upon the lack of an exercise of the inventive faculty. (Citing decisions.)

The decision of this Court in *Electrons, Inc., et al., v. Coe*, 69 App. D. C. 181, 99 F. (2d) 414, 1938 C. D. 72, is cited by appellant as supporting its argument for the patentability of the claims.

It is noted, however, that the discussion by the Court as to the patentability of a claim for a combination of old elements was omitted. In this discussion, after stating when such a combination claim may be patentable, this Court said:

On the other hand, if a combination is the result of mere mechanical skill applied to an idea or ideas previously disclosed, it is not invention. *Paramount Publix Corp. v. American Tri-Ergon Corp.*, 294 U. S. 464 (1935), 452 O. G. 701; see *Walker*, op. cit. *supra*, 138-45.

It is submitted that the claims in suit are clearly not patentable.

III. The de Forest patent, No. 2,110,759, which was granted on application filed July 15, 1935, is not a reference against claims 17 and 18, since those claims are readable upon the earlier Doane application, No. 27,756, which was filed July 21, 1935, prior to the filing of the de Forest application. It is, however, a reference against claim 19 which is limited to the using of a de-ionizing switch which is in no way referred to in the earlier Doane application. That patent shows the same

circuit arrangement as that of the Doane application and describes the use of alternating current with a mercury switch in the circuit.

Certainly, since the de-ionizing switch was old, as shown in the patent to Slepian, and the appellant admits that it has the same characteristic as the mercury switch, of interrupting the circuit at the zero point, there would be no invention in substituting such a switch for the mercury switch of the de Forest patent.

Nowhere in his brief does appellant contend such a substitution was an act of invention.

On page 16 of appellant's brief it is said:

Immediately following the time when Doane made this invention, the invention was accepted by the industry and met with widespread commercial success. (Appellant's App. 77-78.)

However, commercial success has weight in determining patentability only where that question is in doubt (see *Altoona Publix Theatres v. American Tri-Ergon Corp.*, 294 U. S. 477). In the case of *Morrison v. Coe*, 74 App. D. C. 335, 122 F. (2d) 793, 1941 C. D. 75, this Court said:

It is not enough to prove invention, however, to show either usefulness or commercial success; or both of them together.

The District Court in its findings stated that the claims in suit define no invention over the prior art.

This Court has repeatedly held that such findings are presumptively correct and that the question before the Court is whether the finding was consistent with the evidence.

In *Wolf et al. v. Coe*, 72 App. D. C. 224, 112 F. (2d) 857, 1940 C. D. 27, this Court said:

Appellants concede that "no single step of the process is novel per se." Combining previously known steps may or may not show inventive ingenuity. In our opinion the references support the finding that there is no invention here. "The question for us is not whether in our opinion there was invention, but whether

the finding that there was none is consistent with the evidence." *Abbott v. Coe*, 71 App. D. C. 195, 109 F. (2d) 449.

In *Minnesota Mining & Manufacturing Co. v. Coe*, 73 App. D. C. 146, 118 F. (2d) 593, 1941 C. D. 79, this Court said:

Substitution of materials to produce a more efficient article may or may not amount to invention. The question of invention is the question whether "some uncommon talent" is shown. As this is a question of fact we are to decide not whether in our opinion there was invention, but whether the finding that there was none is consistent with the evidence or, what is the same thing, is "supported by the evidence." Whatever else may be said of older decisions that, in appeals from the Patent Office, doubt was to be resolved in favor of the applicant, they are obviously not law in relation to appeals from the district court. (Citing decisions.)

It is submitted that the findings made in this case that the claims in suit define no invention was in no respect inconsistent with the evidence.

CONCLUSION

It is submitted that the District Court properly adjudged that the plaintiff is not entitled to a patent on the Doane application herein involved containing claims 17, 18, and 19, or any of them, and that the judgment of the District Court should be affirmed.

Respectfully submitted.

W. W. COCHRAN,
Solicitor, United States Patent Office,
Washington, D. C.,
Attorney for Appellee.

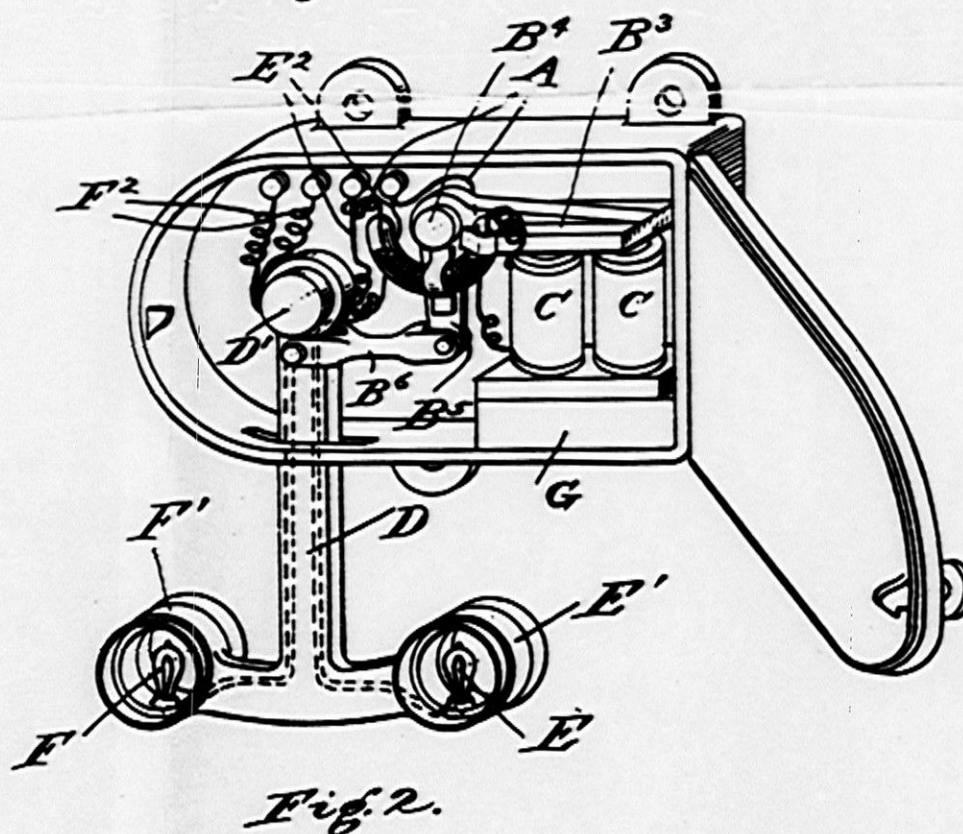
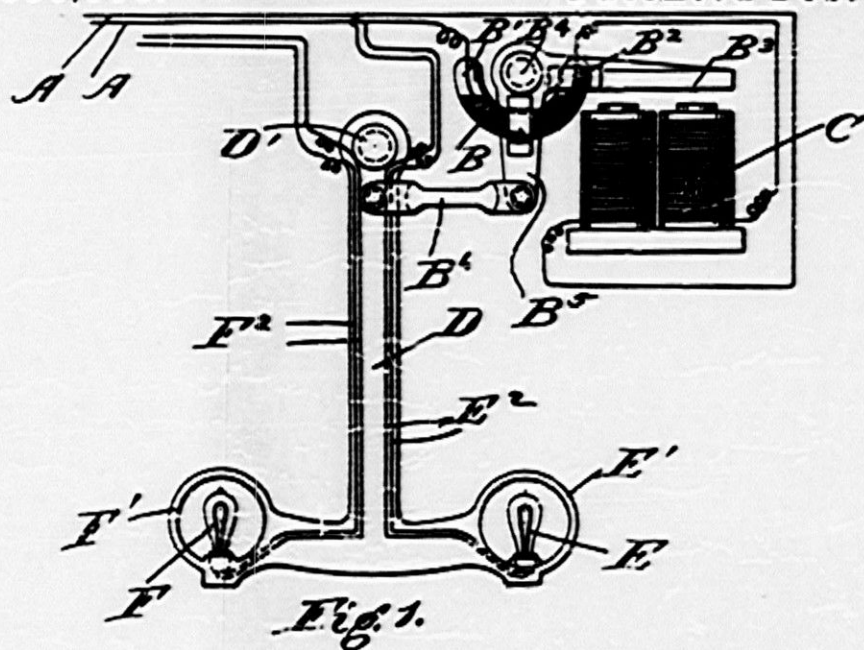
R. F. WHITEHEAD,
Of Counsel.

JANUARY 1943.

D. H. WILSON.
SEMAPHORE FOR RAILWAY SIGNALS.

No. 533,938.

Patented Feb. 12, 1895.



Witnesses:
Walter J. Gunthorp
D. Mearns

Inventor:
David H. Wilson
By Francis W. Parker
Atty

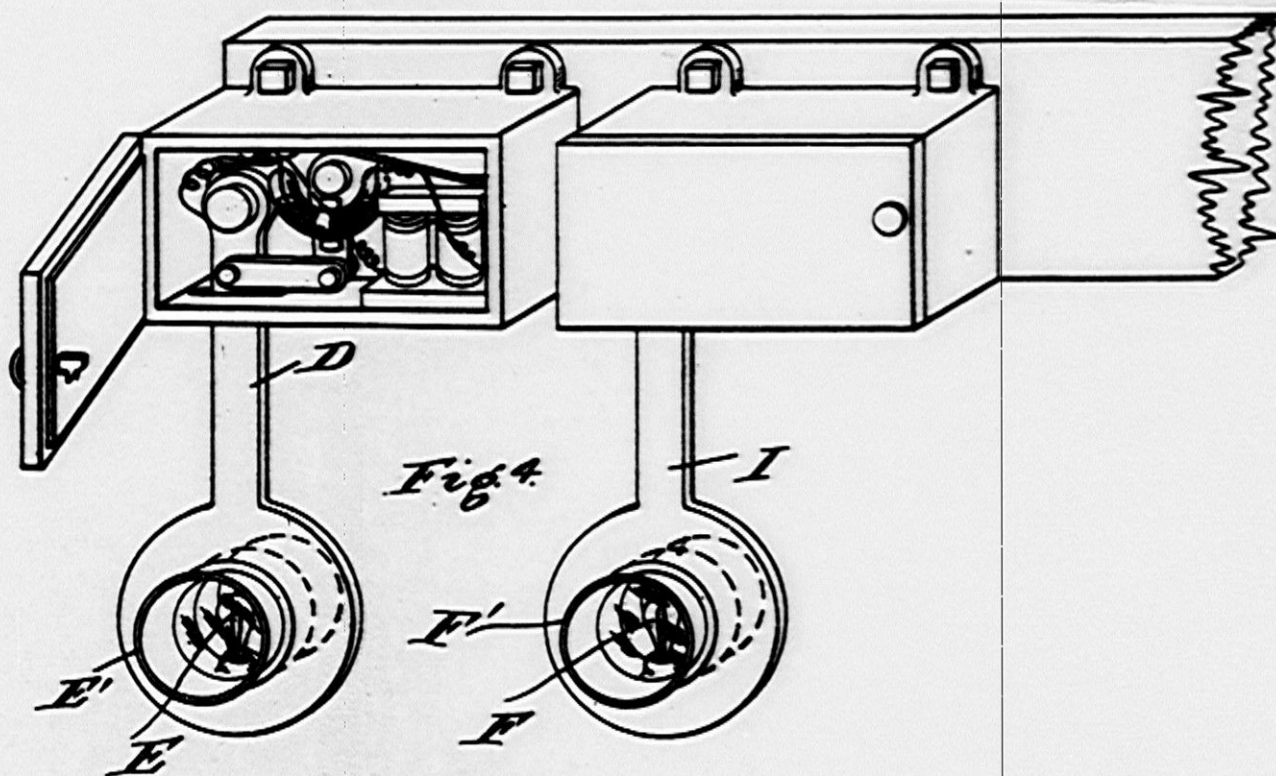
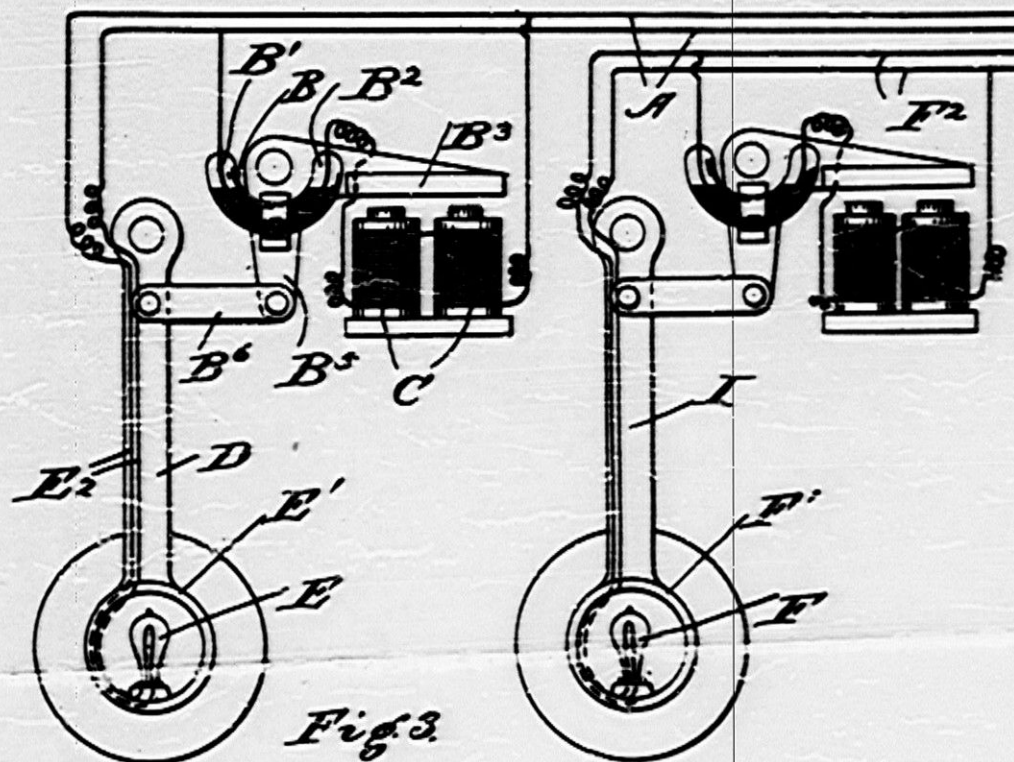
(No Model.)

2 Sheets—Sheet 2.

D. H. WILSON.
SEMAPHORE FOR RAILWAY SIGNALS.

No. 533,938.

Patented Feb. 12, 1895.



Witnesses:
Walter J. Gunthorp
D. Mearster

Inventor:
David H. Wilson
By Francis W. Parker.
Att'y

DAVID H. WILSON, OF CHICAGO, ILLINOIS.

SEMAPHORE FOR RAILWAY-SIGNALS.

SPECIFICATION forming part of Letters Patent No. 533,938, dated February 12, 1895.

Application filed April 23, 1894. Serial No. 508,626. (No model.)

To all whom it may concern:

Be it known that I, DAVID H. WILSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Semaphores for Railway-Signals, of which the following is a specification.

My invention relates to semaphores or visual signals for a system of railway signals, and has for its object to produce a new and improved visual signal of which the following is a description, reference being had to the accompanying drawings, wherein—

Figure 1 is a diagrammatic view of the semaphore and operating mechanism. Fig. 2 is a view of the semaphore and case or box containing the mechanism. Figs. 3 and 4 show the preferred form of my device.

Like letters refer to like parts throughout the several figures.

In most systems of electrically operated railway signals the semaphore or visual signal is operated by an electric motor or the like, the circuit being closed through such motor by the train as it passes into any given section. In my device A A' represents the wires of such circuit. The mercury tube B and electro-magnet C are in series on this circuit. The tube B is partly filled with mercury, entirely exhausted of air, and then sealed, the contacts B' B² being sealed into its ends. The said tube B is fastened in any convenient manner so as to move with the armature B³ of the electro-magnet C. As shown in the drawings the tube is fastened to a bell crank lever pivoted at B⁴. The arm B³ of said lever is the armature of the magnet C, the other end B⁵ being connected by the link B⁶ to the semaphore D which is pivoted at D'. To the bottom or cross arm of the semaphore are attached the electric lamps E F which are protected by the reflecting hoods E' F'. The lamp E is connected to the wires A A by wires E² E³. The lamp F is connected to the wires F² F³ of a separate circuit which is only closed when two trains are in adjoining sections.

Fig. 2 shows the semaphore and mechanism in a box G so as to be easily and quickly put in place along the track. In Figs. 1 and 2 I have shown one semaphore with two lamps attached. The semaphore is set in motion and one lamp lighted when it is to be a for-

ward or rearward signal for one train. When two trains are in adjoining sections the second lamp in the semaphore between the two sections is lighted in addition to the first lamp. Since lamps cannot be seen very well in the day time, I will generally use two semaphores each provided with one lamp as shown in Figs. 3 and 4. The semaphore D is set in motion and lamp E lighted when the circuit is closed through the wires A A; and the semaphore I is set in motion and lamp F lighted when the circuit is closed through wires F² F³.

It is evident that these several parts may be varied in form, construction and arrangement without departing from the spirit of my invention, and I therefore do not wish to be limited to the exact construction shown.

The use and operation of my invention are as follows: It will be understood that this semaphore can be used in any system of electrical signaling. I have shown and described the semaphore with circuits suitable to be used in connection with a system of signals such as I have described in my application filed February 10, 1894, Serial No. 499,733, wherein, when a train enters a section it sets a rear and forward signal; and when two trains are in adjoining sections the signal between the two sections is acted upon by both trains by two circuits. In the accompanying drawings the circuit completed by the forward train is represented by the wires A A, and the circuit completed by the rear train by wires F² F³ when the trains are in this condition.

Referring to Figs. 1 and 2, the operation is as follows: When the semaphore is to show as a rear or forward signal for one train, the circuit is completed through the wires A A, mercury tube B, and magnet C. As magnet C is energized it attracts its armature B³, and since the tube B is attached to said armature said tube is rocked and the mercury displaced so that the circuit is broken. The movement of the armature B³ is communicated to the semaphore D by means of the arm B³ and link B⁶. When the circuit is broken in the tube B the semaphore brings the tube back to its normal position and the circuit is again completed, magnet C energized, and this operation repeated. It will thus be seen that the semaphore D and the lamp E, which is lighted when the circuit through the wires A

A is completed, are moved back and forward while the signal is acting. If now this is the rear signal of a train, and a second train following the first, enters the section to the rear, the circuit through the wires $F^2 F^2$ and lamp F is completed, and two vibrating lights are shown which indicate to the rear train that there is a train in the section ahead. As shown in Figs. 3 and 4 two semaphores D and I are used, each provided with a lamp. The semaphore D and lamp E are worked by the circuit A A', and the semaphore I and lamp F by circuit $F^2 F^2$. In this case the semaphore D and lamp E are operated when a forward or rearward signal is displayed, and both the semaphores D and I and lamps E and F are operated when the signal is between two adjoining sections in each of which there is a train. In this construction I use a semaphore for each light displayed as it is difficult to see lights in the day time, but an easy matter to see a vibrating semaphore.

I have said nothing about the color of the lights displayed, as that is a matter left to the discretion of the company using the signals. The globes of the lamps may be of any desirable color, or colored glasses may be put in the ends of the hoods E' F', or glasses of different colors may be put in the opposite ends of the said hoods. In the latter case it might be found necessary in some instances to divide the hoods by an opaque partition and use two lamps in multiple, instead of one to avoid confusing the colors.

It will be seen that I have here a vibrating semaphore, with lights attached which are only lighted when the semaphores are in motion, and hence the color of the lights is not material, and people who are color blind can interpret the signals as well as persons who can distinguish colors.

One of the chief dangers in displaying stationary lights as signals is the fact that white or open track signals are often confused with

other stationary lights, and even with the headlight of an approaching train, and hence the results obtained by such signals are not satisfactory.

It will be seen that with my device all such danger is obviated, and that there can be no confusion of stationary lights and the displayed signals.

I claim—

1. The combination of an electro-magnet, an armature for the same to which is attached a tube containing mercury and having the air exhausted therefrom, contacts sealed into the ends of said tube, a semaphore and connections between the semaphore and the said armature, whereby the semaphore is vibrated while it is acting as a signal.

2. The combination in a visual signal for a system of railway signals, of two semaphores each carrying a light, an electric device associated with each semaphore and light by which such semaphore and light are vibrated when acting as a signal, said electrical device comprising an electro magnet, an armature for the same to which is attached a tube containing mercury and having contacts sealed into the ends thereof whereby, when the track is clear only one semaphore and lamp are set in motion, and when the track is obstructed both are vibrated substantially as described.

3. The combination of an electro-magnet, an armature for the same to which is attached a tube containing mercury and having the air exhausted therefrom, contacts sealed into the ends of said tube, a semaphore and connections between the semaphore and the said armature, whereby the semaphore is vibrated while it is acting as a signal, and a light or lights attached to said semaphore so as to vibrate therewith.

DAVID H. WILSON.

In presence of—

DONALD M. CARTER,
WALTER J. GUNTHERP.

P. C. HEWITT.
CIRCUIT CONTROLLER.
APPLICATION FILED AUG. 10, 1903.

Fig. 1

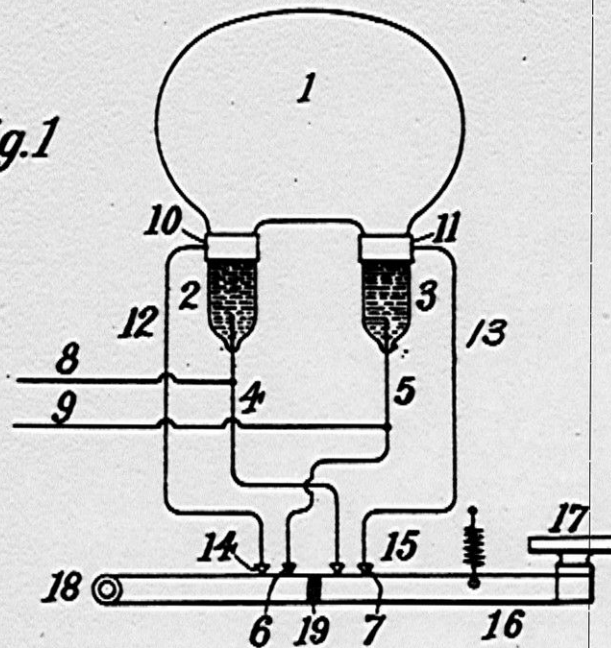


Fig. 2

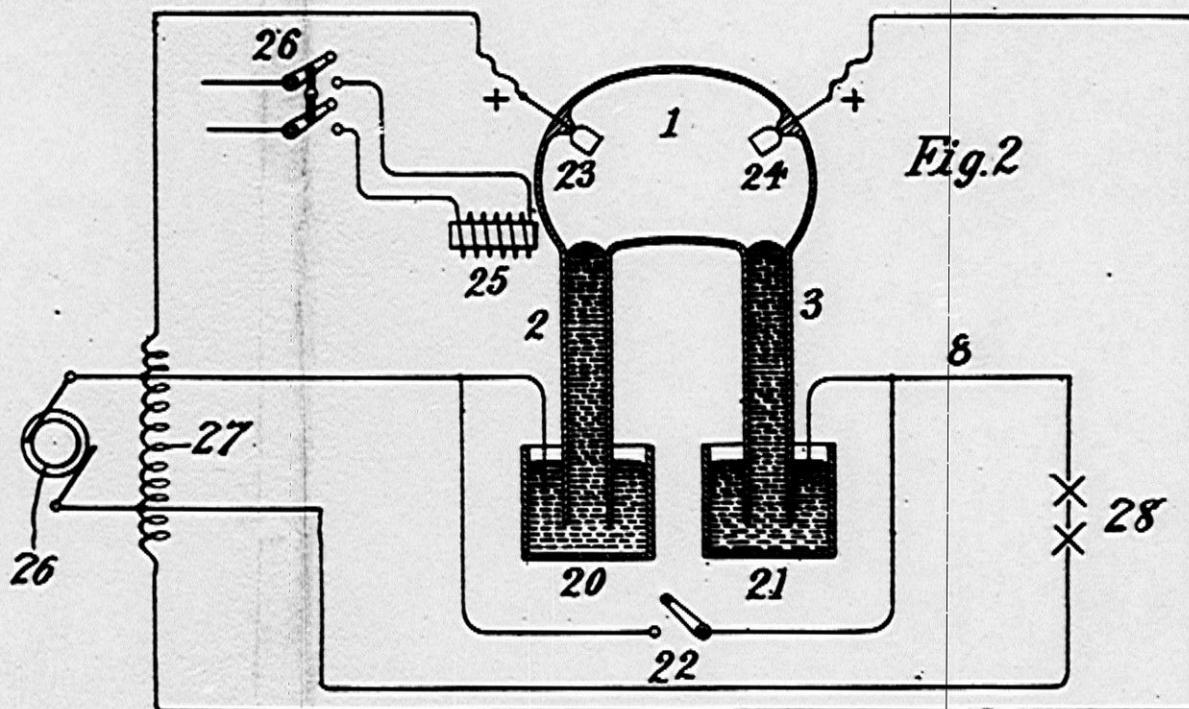
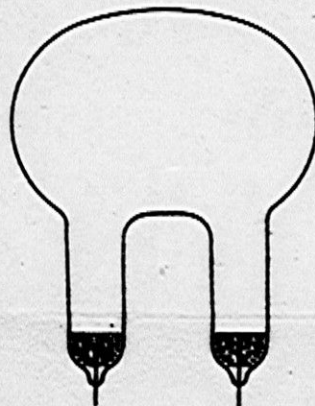


Fig. 3



Witnesses:

Thos. H. Brown, Jr.
W. H. Capel

Inventor

John Cooper Hewitt.
by Charles A. Ring. Atty

PETER COOPER HEWITT, OF NEW YORK, N. Y., ASSIGNOR TO COOPER
HEWITT ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CIRCUIT-CONTROLLER.

No. 799,052.

Specification of Letters Patent.

Patented Sept. 12, 1905.

Application filed August 10, 1903. Serial No. 168,983.

To all whom it may concern:

Be it known that I, PETER COOPER HEWITT, a citizen of the United States, and a resident of New York, county of New York, State of New York, have invented certain new and useful Improvements in Circuit-Controllers, of which the following is a specification.

My invention relates to an improved type of electric switch for controlling circuits in which currents of high potential or large quantity are carried.

The invention is applicable to various different classes of electrical circuits, and has special advantages in connection with power-circuits or circuits carrying currents of such voltage and quantity as to render it difficult to interrupt the main circuit connections by a switch or circuit-breaker without undue sparking at the contact-plates.

The significant feature of the switch which I have invented is that of introducing into the circuit to be controlled the resistance of a gas or vapor electric apparatus under such conditions as will, for example, stop the current-flow in the circuit without the development of any deleterious sparking and without causing a dangerous rise of potential in any part of the circuit.

In embodying my invention in a working device I may make use of a gas or vapor electric apparatus similar in a way to that described in certain patents issued to me on the 17th day of September, 1901. It is now well known that apparatus of this character has the property of exhibiting at one electrode a reluctance to starting; but when such reluctance is overcome the apparatus will conduct current down to some lower current value, whereupon the reluctance to starting will be reconstructed and a renewal of the starting pressure has to be applied in order to reestablish the flow of current.

When current is applied to the terminals of the apparatus, an electric strain is produced at or near the electrode in question, and if such strain is increased to a critical point the reluctance is overcome and current begins to flow, as described. The critical strain thus added to the strain created by the application of current to the terminals may be applied through the usual starting-band, which when placed in proximity to the electrode modifies the degree of reluctance to starting. The critical strain may, however, be applied

through a supplemental electrode or by other means.

In case of an alternating current where it is desired that impulses of opposite direction should pass through the apparatus means may be provided for applying the critical strain to a starting-band in the neighborhood of each electrode or to a supplemental electrode or electrodes or the like, whereby the several alternations will be caused to traverse the apparatus after successive operations of the critical strain in breaking down the described reluctance.

It has been found that when a starting-band or supplemental electrode with the described connections is present the apparatus will start at a lower line potential than when such devices or their equivalent are not used. Accordingly an apparatus suitably provided with such aids to starting may be operated upon currents of definite potential, provided the potential is high enough to furnish in the first instance the necessary breaking-down strain.

In one of the embodiments of my invention as herein disclosed I include an apparatus of the class described in an alternating-current circuit carrying currents from which it is desired to obtain periodic impulses of high frequency.

The potential of the current carried by the circuit is assumed to be high enough to operate the apparatus when the starting-bands or their equivalent are suitably connected with the circuit; but it is assumed that when the starting-bands are disconnected the potential would be insufficient to operate the apparatus. Therefore the operation of the apparatus, and consequently the condition of the circuit in which it is included, is dependent upon whether or not the starting-bands or their equivalent are connected in circuit. I may then control the circuit by means of a simple key, which either opens or closes at will the connections of the starting-bands or whatever devices may be substituted for such bands in actual practice.

In another embodiment of my invention I utilize a gas or vapor apparatus as a means for opening an electric circuit, either direct or alternating, without the formation of an arc or a dangerous rise of potential. In this instance the apparatus is first started by any suitable means and the rupture of the circuit takes place through the action of a magnet

upon the current passing through the gas or
vapor electric apparatus. Such rupture may,
however, be made by means of heat generated
by the current passed, whereby the potential
5 required to pass current through the appara-
tus is increased beyond the potential of the
line. I have illustrated the apparatus as be-
ing placed in a shunt-circuit to a switch, on
the opening of which current begins to pass
10 through the vapor apparatus and is then rup-
tured through the action of a magnet. Under
such circumstances the gas or vapor appara-
tus does not form a part of the work-circuit
and only comes into play when the described
15 switch is operated. The apparatus might,
however, be included in the work-circuit, as
in the case already described. In that case
the magnet might be used to prevent starting
until the desired moment of starting arrives.
20 The device might then be started after cut-
ting out the magnet, and the subsequent rup-
ture of the current through the action of the
magnet might be caused at any desired mo-
ment and without injurious effects. The cur-
25 rent might be interrupted, as indicated above,
by the automatic action of the device itself—
that is to say, the immediate action of the
current itself upon the vapor or gas may be
such as to prevent the current from reëstab-
30 lishing its flow after it has passed the zero-
point. In many instances the discharge at
the moment of interrupting the switch con-
nections will be sufficient to cause an initial
flow through the device, thus absorbing the
35 discharge-spark, which would otherwise take
place at the contact-plates, while the device
would prevent the flow of current under the
normal pressure of the circuit, so that the
flow of current through the circuit would be
40 interrupted at the zero-point of the alternating
wave.

In the drawings, Figure 1 illustrates a circuit
provided with means for opening and closing
connections to the starting-bands. Fig. 2 is
45 a diagrammatic illustration of the magnetic-
ally-operated switch, and Fig. 3 illustrates a
modification.

Referring to the drawings, 1 represents a
container inclosing a conducting gas or vapor,
50 and 2 and 3 are electrodes, which are here
shown as being contained in tubular exten-
sions of the container. The lead-wires to the
respective electrodes 2 and 3 are shown at 4
and 5; and they terminate, respectively, in
55 contact-pieces 6 and 7. The mains of the
work-circuit are illustrated at 8 and 9, these
mains being respectively connected to the
lead-wires 4 and 5.

The starting-bands are shown at 10 and 11,
60 and they are connected by wires 12 and 13
with contact-pieces 14 and 15, respectively.
The contact-pieces 6, 7, 14, and 15 are so ar-
ranged as to be touched by the shank 16 of
a key or circuit-breaker having an operating

button or handle 17. The key is pivoted at 65
18. Its position is regulated at the will of
the operator either so that its shank shall be
in contact with the contact-pieces already
mentioned or out of contact, as the case may
be. An insulating-piece 19 divides the shank 70
of the key into two insulated parts, so as to
prevent short circuits.

When the parts are in the position illus-
trated in Fig. 1, each of the starting-bands 10
and 11 is connected with the lead-wire run- 75
ning to the opposite side of the apparatus,
and accordingly the conditions are suitable for
the creation of a breaking-down strain suf-
ficient to cause the passage of current in both
directions through the apparatus, provided 80
the potential on the mains 8 and 9 is high
enough. In this case the potential is assumed
to be sufficiently high for the purpose, but
only under the conditions that the starting-
bands are connected as described. 85

Should the operator now depress the key
and remove the shank from contact with the
several contact-pieces, the flow of current
through the apparatus would continue only
until the zero-point of the wave then passing 90
should be reached, after which no renewed
breaking down of the reluctance would take
place, the result being that the circuit 8 and
9 would be practically opened.

Referring to Fig. 2, the apparatus is here 95
represented with its electrodes 2 and 3 in the
form of columns of mercury ending in vessels
20 and 21, containing mercury. The length
of the shanks in which the columns are con-
tained is made such that atmospheric pressure 100
will carry the inner ends of the columns to a
height where they can properly serve as elec-
trode-surfaces. The circuit in this instance, as
before, is an alternating-current circuit, hav-
ing a switch 22 interposed in one of the mains 105
8. The gas or vapor apparatus is included in
a shunt around the switch. I here substitute
for the starting-bands shown in Fig. 1 two
supplemental electrodes 23 and 24, each of
which is connected to the circuit on the oppo- 110
site side of the apparatus.

The connections of the supplemental elec-
trodes 23 24 are indicated in Fig. 2, where
an alternating-current generator 26 is shown
as being connected to the main 8, including 115
translating devices 28 28, while the electrodes
23 24 are connected through an autotrans-
former 27 with the opposite side of the circuit.

As a means for rupturing the circuits I
make use of an electromagnet 25, whose cir- 120
cuit is controlled by a switch 26. The effect
of the magnet is to deflect the current passing
through the apparatus, and I have found that
its effect may be large enough to actually
rupture the current and interrupt the flow 125
through the apparatus.

In operation when the switch 22 is closed
no current passes through the vapor appa-

ratus. On opening the switch 22 the current in the main circuit passes through the conducting-gas in the chamber 1 in alternating phases, it being understood that the current is of sufficient volume and electromotive force to break down the electrode reluctance except when the circuit through the switch 22 is closed.

The action as a whole may be described as follows: The switch 22 is opened and current begins to flow through the vapor apparatus, after which the switch 26 is closed, energizing the magnet 25, whereupon the current in the chamber 1 is deflected sufficiently to rupture the circuit. The magnet 25 may be supplied from any suitable source. It may be replaced by an adjustable permanent magnet, if desired. The action in respect to the effect of the magnet upon the current would be the same if no by-path were provided as by the circuit including the switch 22—that is to say, if the gas or vapor apparatus were normally a part of the main circuit.

In many instances the magnet will not be required, as the discharge occurring at the opening of the switch 22 may be sufficient to cause a current to pass through the vapor path, although that path is of sufficient effective resistance as not to be penetrated by the normal current upon the circuit, so that the harmful discharge which would otherwise occur at the opening of the switch 22 will be obviated by the passage of the high-potential current through the gas or vapor path, but it will cease upon the potential falling to the normal potential of the circuit.

The modification illustrated in Fig. 3 is simply intended to show an appropriate shape for the vapor apparatus, the form illustrated being given to it for the purpose of making the current pass into the electrodes nearly at right angles to the surface in order to facilitate the action of the magnet upon the current. This is done because it has been found that a magnet will have a greater effect upon the current if its lines of force are arranged as to act upon the current as nearly as possible at right angles to the line of flow.

It is not intended that the present invention should be limited to the control of alternating currents, as it may be readily adapted to the control of direct currents as well.

Manifestly the devices illustrated in Fig. 1 for producing conditions of conductivity and non-conductivity in the gas or vapor might be substituted for those shown in Fig. 2—that is to say, they might be included in a shunt-circuit to a switch or any other device and they would operate on the same principle in either case.

The method of rendering a gas or vapor apparatus electrically conducting or non-conducting at will is not necessarily confined to the employment of means as herein described

for applying a critical strain to the apparatus. For example, the same effect may be produced by means which will suitably affect the physical or chemical conditions of the gas or vapor, rendering the same conducting or non-conducting, as desired.

While the action of the apparatus herein disclosed has been described more particularly with reference to its capacities as a means of stopping the flow of electrical energy in a circuit or circuits, yet it should be understood that the same apparatus is equally well adapted to perform the other functions of an electric switch—that is to say, to start a circuit or circuits into operation. For example, the movement of the key away from the contacts in Fig. 1 has been described as a means of stopping the flow of energy in the mains 1 and 2. The restoration of the key to a position of contact would start the flow of energy again in the said mains.

In another application filed by me March 7, 1903, Serial No. 146,652, claims are made upon the method described herein.

I claim as my invention—

1. A device for preventing abnormal discharges at the contact-plates of a circuit-interrupter, comprising an inclosed gas or vapor having terminals connected in shunt upon the circuit-interrupter.

2. The combination with a circuit-interrupter, of a device for preventing injurious arcs at its contact-plates upon the interruption of a circuit thereby, consisting of an inclosed gas or vapor path, terminals leading therefrom, and connections from said terminals with contacts of the circuit-interrupter, substantially as and for the purpose described.

3. In a system of electrical distribution, a main circuit, a circuit-opening device therein, a shunt around the said device, an inclosed gas or vapor included in said shunt, means for passing current through the inclosed gas or vapor when the circuit-opening device is operated.

4. In a system of electrical distribution, a main circuit, a circuit-opening device therein, a shunt around the said device, an inclosed gas or vapor included in said shunt, means for passing current through the inclosed gas or vapor when the circuit-opening device is operated, and means for afterward rendering the gas or vapor non-conducting.

5. In a system of electrical distribution, a main circuit, a circuit-rupturing device therein, a shunt around the said device, an inclosed gas or vapor included in said shunt, means for passing current through the inclosed gas or vapor when the circuit-rupturing device is operated and means for deflecting the current in the conducting gas or vapor so as to cause a rupture thereof.

6. In a system of electrical distribution, a main circuit, a circuit-rupturing device there-

in, a shunt around the said device, an inclosed
gas or vapor included in said shunt, means
for passing current through the inclosed gas
or vapor when the circuit-rupturing device is
5 operated and magnetic means for deflecting
the current in the conducting gas or vapor so
as to cause a rupture thereof.

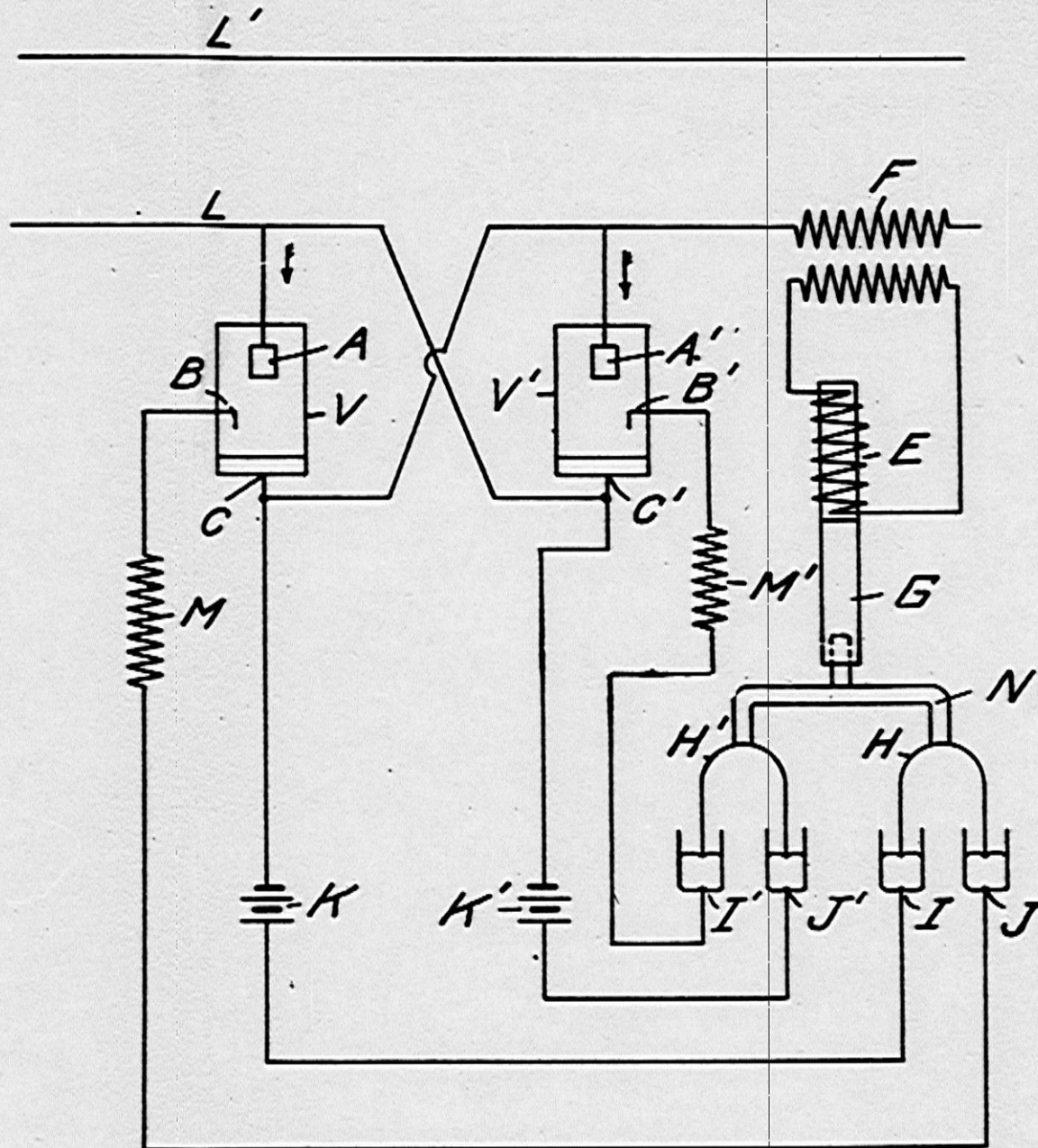
Signed at New York, in the county of New
York and State of New York, this 6th day of
August, A. D. 1903.

PETER COOPER HEWITT.

Witnesses:

WM. H. CAPEL,

GEORGE H. STOCKBRIDGE.



Witnesses:

Josephine H. Ryan
 Charles S. Woodbury

Inventor:

Charles A. Kraus
 By Robert R. Robinson
 Attorneys

104800

104800
104800
104800

UNITED STATES PATENT OFFICE

CHARLES A. KRAUS, OF NEWTON HIGHLANDS, MASSACHUSETTS.

VAPOUR-ARC CIRCUIT-BREAKER.

1,046,086.

Specification of Letters Patent.

Patented Dec. 3, 1912.

Application filed April 5, 1912. Serial No. 688,816.

To all whom it may concern:

Be it known that I, CHARLES A. KRAUS, a citizen of the United States, and resident of Newton Highlands, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Vapor-Arc Circuit-Breakers, of which the following is a specification.

My invention relates to devices for interrupting currents in alternating current transmission systems, and has for its object the elimination of dangerous and destructive arcs to which circuit breakers now and heretofore employed are liable.

The system for circuit breaking which I have invented is characterized by the interruption of current-maintaining conditions at or near that stage in the alternating circuit when current is zero. At the present time circuit breakers for high potential alternating currents operate by separating a pair of copper blocks immersed in oil. Repeated operation of such a circuit breaker results in rapid deterioration of the oil, necessitating frequent renewal, and this, in service lines which are in practically continuous operation, is disadvantageous and may be dangerous as well as expensive both as to time and materials. But a more serious defect inherent in the construction and operation of such circuit breakers lies in the fact that the break may come at a time when the current has considerable magnitude; under these conditions electrical oscillations are liable to be set up especially where underground covered cables constitute the lines.

I am aware that attempts have been made to employ a mercury arc for circuit breaking, as by severing a column of mercury by tipping a suitably shaped apparatus or by lifting an electrode out of a body of mercury. Such a contrivance involves either the rapid movement of a considerable body of mercury or of a necessarily heavy movable electrode, either of which can be accomplished only with difficulty and usually with danger to the mercury containing vessel.

It is well known that if an arc be maintained from a mercury cathode surface in a vacuum container, current will pass readily from a solid anode to the mercury cathode, whereas current will not flow in the reverse direction. Therefore, if such a mercury arc check valve is included in an alternating current line, a pulsating current will flow through the vacuum apparatus in one

direction, this current being substantially all of the normal alternating current in that direction. But it is necessary that an arc be maintained continuously in the vacuum apparatus, otherwise no current will flow through it. By combining two check valves of this character and connecting them in the line in parallel but in opposite directions, or as it may be expressed, in parallel opposition, a normal alternating current will flow through the line, the current in one direction flowing through one check valve and that in the other direction through the other check valve, and the loss of energy in the arcs will be small, amounting only to about one-tenth of one per cent. in a 15,000 volt line. But as already stated, the alternating current will flow through the line only so long as the arcs are maintained in each of the vacuum check valve devices during the half cycle when the line current is shut off by the characteristic check valve action. Thus, in vacuum check valve apparatus it is necessary to include auxiliary arc-maintaining devices so that when the half cycle is reached, which the check valve will permit to pass, an arc will exist and therefore supply the necessary arc connection.

My invention depends for its operation on the above briefly outlined characteristic conditions.

Referring to the drawing hereto annexed which illustrates an example of my invention in diagrammatic form, L, L' represent the line wires of a single phase alternating current transmission line. In the line wire L two electric check valves V, V' are connected in parallel opposition, so that the current flowing in one direction in the line wire L will pass from the anode A in check valve V to the cathode C and thence to the line wire again, while current in the opposite direction will flow from the anode A' in check valve V' to and through cathode C' and thence again to the line wire L. In order to maintain the arcs in these check valves, auxiliary anodes B, B' are provided which in the instance herein indicated are included in auxiliary circuits of which the electromotive source is independent of the main line, L, L', and may consist of batteries indicated by K, K'. Controlling resistances M, M' are included in the auxiliary arc-maintaining circuits if desired. Each arc-maintaining circuit is maintained in closed condition by switches represented by

the mercury contact pools I, J and I', J' and the circuit breaking members H and H'. These circuit breaking members are connected to a yoke N of insulating material which is carried or controlled by a solenoid armature G, the latter being of such weight as to respond only to abnormal current conditions in the solenoid E which is in circuit with the secondary of the transformer F, this being coupled with a primary in the line L.

So long as normal conditions prevail in the line L, the contact members H, H' will remain in contact with the mercury pools I, J, and I', J', and the auxiliary arcs will be maintained between anodes B and B' and cathodes C, C', respectively. Thus the check valves V and V' will maintain their normal operation to maintain the continuity of the line circuit. In case of sudden overload or of short-circuit in the line, the auxiliary arc maintaining currents are automatically cut off by the operation of the above described apparatus and the main line current is interrupted until the auxiliary arc maintaining currents are again set in operation. If current in the main line exceeds any desired prescribed value, the plunger or solenoid armature G is raised and with it the contact members H and H', breaking the auxiliary arc-maintaining currents. As soon as the auxiliary currents are broken the main line current ceases and will not continue to flow until the arcs are again started in the check valve devices V and V'. It is obvious that the condition of maintenance of the main line current is interrupted by the operation of the foregoing devices at or near the point when the main current is zero. During the normal passage of the current no strain is put upon the insulation of the check valves V and V' since the potential across them is only that of the arc, namely, about 15 volts. When the auxiliary arcs are cut off, however, and the check valves cease their operation, the potential across the valves will be the entire line potential.

Aside from the advantage of cutting off the current at the zero point, the apparatus which I have devised has the advantage of

operating as quickly as desired when a heavy short circuit takes place. In the present forms of circuit breakers very massive parts are necessarily employed which cannot be made to operate rapidly owing to their inertia. Since, however, in my device only small auxiliary currents of from 3 to 5 amperes are broken, the moving parts may be made very light so that when once the system begins to move its motion will be completed in a very short interval of time. If desired the current may be cut off in the space of a single cycle. The main current cannot be started again until the auxiliary arcs are set in operation. Various means are already known for starting the arcs in vapor apparatus and since these are familiar to anyone versed in this art, no arc starting devices are shown. If it is desired an oil switch may be placed in series with the mercury arcs, so that the potential strain may be removed from the valves when the current has once been broken.

I claim:

1. The combination in an alternating current transmission system, of a line, two vapor arc check valves connected in parallel opposition in the line, auxiliary arc-maintaining devices in each check valve, and means controlled by abnormal current conditions in the line to interrupt current in the auxiliary arc-maintaining devices.

2. The combination, in an alternating current transmission system, of a line, two vapor arc check valves connected in parallel opposition in the line, auxiliary arc-maintaining devices in each check valve, a source of current for said auxiliary devices independent of the line current, and means controlled by abnormal current conditions in the line to interrupt current in the auxiliary arc-maintaining devices.

Signed by me at Boston, Massachusetts, this 18th day of March, 1912.

CHARLES A. KRAUS.

Witnesses:

ODIN ROBERTS,

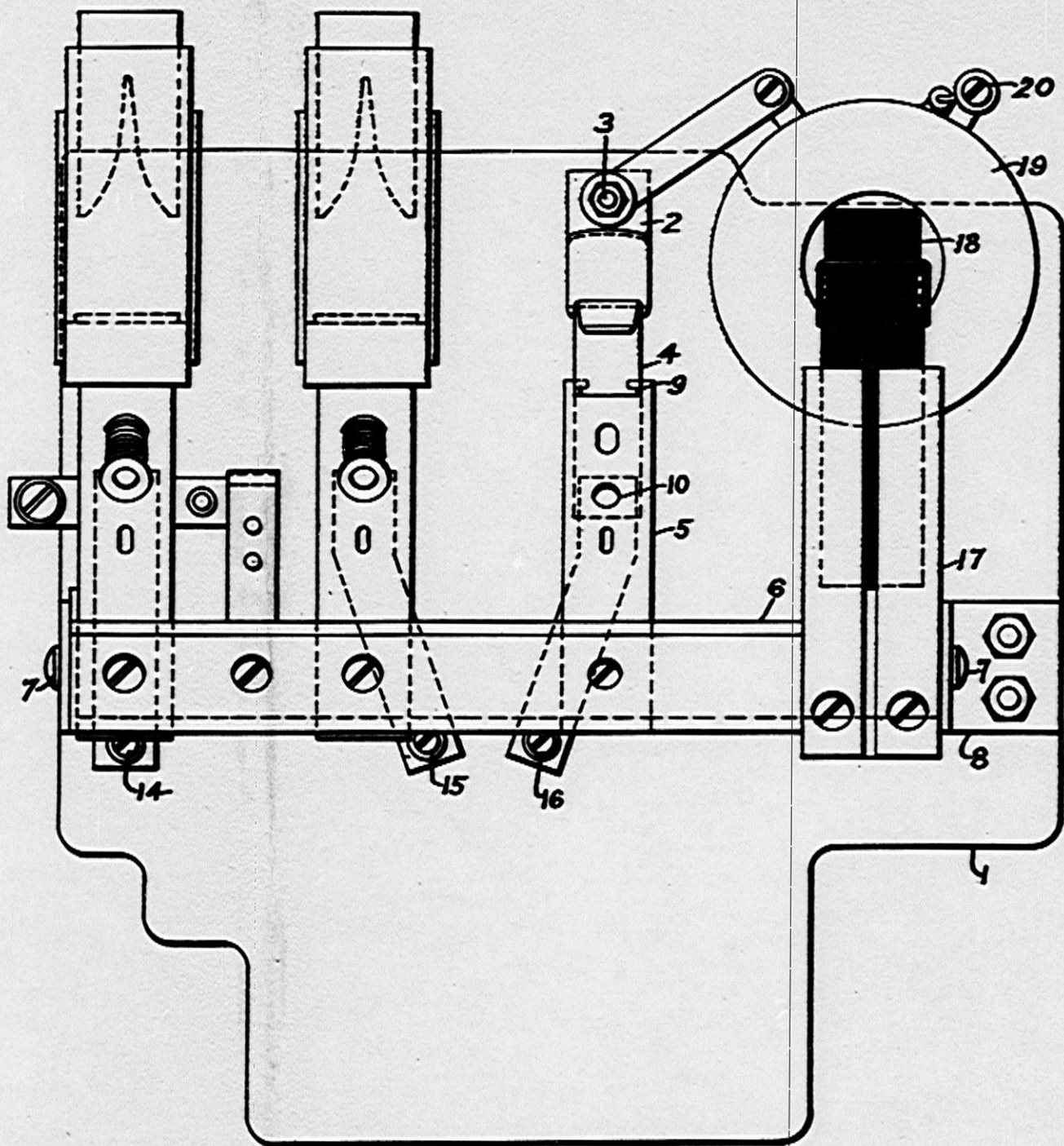
CHARLES D. WOODBERRY.

CIRCUIT BREAKER

Filed April 29, 1927

2 Sheets-Sheet 1

Fig. 1.



WITNESSES:

R. Williams

F. W. Lyle.

INVENTOR

Joseph Slepian

BY

Wesley H. Barr

ATTORNEY

Oct. 24, 1933.

J. SLEPIAN
CIRCUIT BREAKER

Filed April 29, 1927

1,932,090

2 Sheets-Sheet 2

Fig. 2.

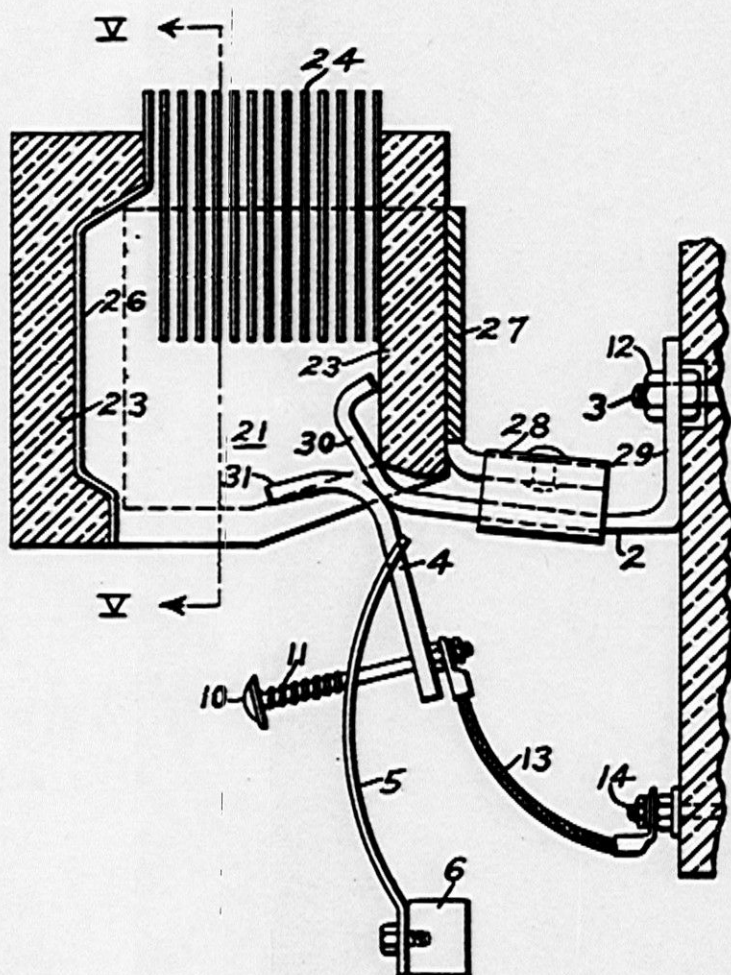


Fig. 3.

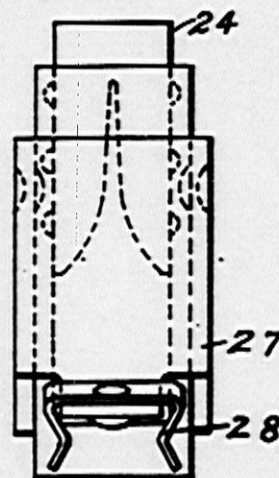


Fig. 5.

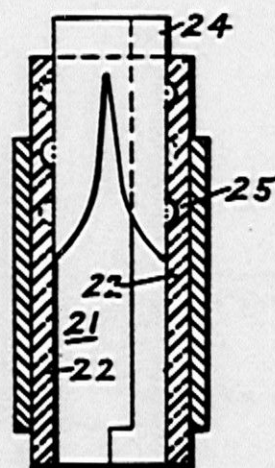
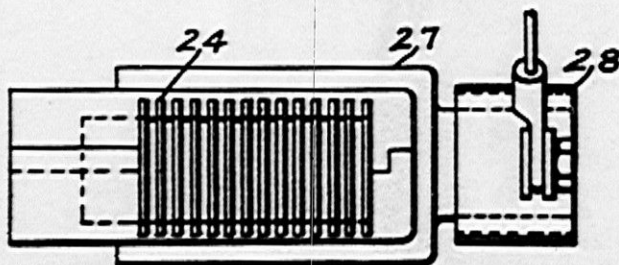


Fig. 4.



WITNESSES:
R. S. Williams
F. W. Lyle.

INVENTOR
Joseph Slepian
BY
Wesley H. Carr
ATTORNEY

UNITED STATES PATENT OFFICE

1,932,090

CIRCUIT BREAKER

Joseph Slepian, Pittsburgh, Pa., assignor to
Westinghouse Electric & Manufacturing Com-
pany, a corporation of Pennsylvania

Application April 29, 1927. Serial No. 157,451

11 Claims. (Cl. 200—144)

My invention relates to circuit breakers, and particularly to arc extinguishing devices therefor.

One object of my invention is to provide means for interrupting the flow of electricity through gaseous media.

Another object of my invention is to provide a circuit breaker provided with an arc-interrupting device capable of opening high voltage large current arcs in air or in gases, without recourse to oil or other arc-quenching media. Some of the aspects of my invention are, however, applicable in connection with devices for opening circuits of lower power and to a variety of other uses.

The principal field for immediate application of my invention is in connection with alternating-current circuit breakers and I shall, therefore, describe an embodiment of my invention as applied to such circuit breakers, without in any way intending to restrict the scope of my invention, except as indicated in the appended claims.

According to my invention, the arc incident to the opening of a circuit is driven into a deionizing structure comprising a series of spaced metallic plates having tapering notches aligned to form a V-shaped groove. When forced into the apex of this groove, there is a large deionizing action, and the arc is extinguished as the current passes through zero.

By thus rapidly eliminating the ionization that would otherwise maintain the electrical conductivity of the path until the line voltage had risen sufficiently to reignite the arc, current flow through the circuit breaker is effectively stopped.

Other objects of my invention will become apparent upon reading the following specification.

In general, my invention comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

For a more complete understanding of the nature and objects of my invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which,

Fig. 1 is a general face view of a contactor adapted for controlling circuits comprising three line conductors and which embodies my invention,

Fig. 2 is a sectional view of the main arcing contacts and the deionizing chamber associated with one supply line or contactor,

Fig. 3 is a rear view of the deionizing chamber,

Fig. 4 is a top view of the deionizing chamber,

and,

Fig. 5 is a sectional view on the lines indicated by V—V in Fig. 2.

Referring to the drawings, my contactor comprises a base 1 of insulating material which carries stationary members 2 of each pair of principal contact members, the members 2 being bolted directly to the base 1. Each stationary member 2 is provided with a suitable terminal stud 3 to which supply line connections may be made in the ordinary manner of the art.

The contacts 2 have a peculiar structure which will be more fully described in connection with the blowout magnets associated therewith. The movable member 4 of each pair of contacts is supported on the free end of a contact support 5, the other end of which is fixed to a cross bar 6 which is supported, in turn, on trunnions 7 seated in brackets 8 supported by the base 1. The contact member 4 passes freely through a slotted recess 9 near the end of the member 5 and, when the contactor is open, is loosely held in place by a stud 10. Stud 10 passes through a hole in the contact support 5 and also passes, with a loose fit, through another hole near one end of the contact member 4.

A spiral spring 11 is fastened loosely on stud 10 and holds contact member 4 in engagement with contact member 2 when the circuit breaker is in its closed position. By this convenient arrangement the stud 10 and spring 11 form an integral unit which may be removed bodily from the holes in members 4 and 5 when so desired. Nuts 12 holding contact members 2 in their above described position permit the easy removal and replacement of the latter members.

Current entering the member 4 from members 2, when the breaker is closed, is conducted away by flexible leads 13, the stationary ends of which are attached to suitable studs 14, 15 and 16 fixed in the base member 1. Connection of the load-line conductors may be made directly to the studs 14, 15 and 16, if desired. Alternatively, overload or other control relays of known type may be made connected to any of these studs; and, if desired, some of these relays may be mounted on the lower portion of the base plate 1.

The cross bar 6 is arranged to be turned upon its trunnions 7 by a lever arm 17 which is positioned to be attracted by a magnetic core 18 when the latter is excited by current supplied to the solenoid 19 as a consequence of closure of an auxiliary control circuit 20 appertaining thereto. This control circuit may derive energy from any convenient source, for example, from two of the line terminal studs 3, and may include any series

of relay contacts by which it may be desired to control the opening and closing of this contact. Such relays are well-known in the art and constitute no part of this invention.

5 When the solenoid 19 is energized by completion of the control circuit, the lever arm 17 is attracted toward the core 18; the cross bar 6 is turned on its trunnion 7 and thereby moves contact members 4 into engagement with contact members 2, thus closing the line circuits. The lever arm 17 is so disposed relative to the trunnions supporting the cross bar 6 that the weight of the lever arm 17 tends to so turn the cross bar 6 as to move contacts 4 backward and away from contacts 2. Upon interruption of the control-circuit 20 the weight of lever arm 17 thus separates contacts 2 and 4 thereby opening the contactor.

The foregoing describes the general structure of my contactor and its operating mechanism. In what immediately follows the deionizing structure which constitutes a principal feature of my invention will be described.

Each pair of contacts 2 and 4 is supported in a chamber 21 shown in detail in Figs. 2 to 5, inclusive. These chambers have side walls 22 and end walls 23 of a refractory insulating material; but are open at the top and bottom. This chamber 21 is hereafter referred to as the deionizing chamber, and when the contacts 2 and 4 open, the resulting arc is drawn within the lower half of chamber 21. Fig. 2 shows chamber 21 in the upright position it will have when the contactor is installed on an ordinary switchboard, and the words "upper" and "lower" herein refer to such installation.

In the upper half of the chamber 21 are positioned a series of vertical metal plates 24, the configuration of each of which is indicated by Fig. 5. These plates may be of copper about $\frac{1}{8}$ of an inch thick and they may be spaced about $\frac{1}{2}$ of an inch apart between their adjacent faces. They are fixed in the walls of the chamber 21 by the small projections 25 fitting in corresponding sockets in those walls. This series of plates extends across the entire opening in the upper end of the chamber 21 and their function is to aid in deionizing the arc drawn in chamber 21 in consequence of the opening of contacts 2 and 4, as will more fully appear hereinafter.

Each stationary contactor 2 is formed in what may be roughly described as a U-shape and as is shown in Fig. 2. The arm of the U farthest from the base plate 1 extends into the chamber 21 in close proximity to the innermost member of the series of metal plates 24.

The end wall of the chamber 21 farther from the base plate 1 is faced inside by a strip 26 of the same metal as the plates 24 above described, but while the upper end of strip 26 is only about $\frac{1}{8}$ of an inch from the nearest deionizing strip 24, its lower portion is bent outward so that about 8 times that distance intervenes between it and the lower end of the nearest one of plates 24. This is shown in Fig. 2.

The contour of the upper end of plates 24 is rectangular, but their lower edge is in the form of a reentrant notch with sides curving together to a rounded apex about two-thirds of the way toward the upper end of the plate.

Figs. 3 and 5 show the general outlines of this notch which may be roughly described as of V-shape. When the plates 24 are mounted in the housing 21, these V-shaped notches aline to form a V-shaped groove into which the arc may be driven to aid in quenching it.

The chamber 21 is held snugly embraced between the arms of an iron plate 27 of U-shape, the chamber 21 being, in reality, made up of two symmetrical halves of insulating material held together by the pressure of the arms of the members 27 between which they are pushed with a friction fit. This is shown more plainly in Figs. 4 and 5, while Fig. 2 shows the shape of the side plates constituting the arms of the U which have their upper edges near the level of the apex of the V-shaped groove above mentioned, and their lower edges slightly above the bottom of the arcing chamber. This iron plate member 27 acts as a blowout magnet for the arc drawn between contacts 2 and 4, since a magnetic field is set up transverse to the deionizing chamber in consequence of the magneto-motive force due to current flowing in the arcing contacts 2 and 4, as will be explained more fully below.

The deionizing chamber 21 is held in position relative to the contacts 2 and 4 by a clip 28 which is adapted to slip with a spring fit over the contact member 2, as will be apparent from an inspection of Fig. 2.

As has been mentioned, contact member 2 is formed in substantially a U-shape. One arm 29 of the U is affixed to the base plate 1 by stud 4 while the other arm 30 of the U stands inclined at a slight angle to the face of the base plate 1, but spaced away from it. The U-shaped iron plate 27 thus loops around the arm 30 of contact member 2; arm 30 may be termed an arcing horn. Similarly the end 31 of contact member 4 is bent to substantially a right angle and members 2 and 4 are so positioned on their supports that when the contactor is closed, contact is made between them at the lower end of their arc horns 30 and 31. Fig. 2 illustrates this construction.

In consequence of the above-described arrangement, when the contactor opens under load the movement of the contact member 3 away from the contact member 2 draws an arc between the lower ends of their respective arc horns 30 and 31. The flow of this current in the arm 30 of member 2 exerts a magneto-motive force to set up in the iron plate 27 a flux which crosses the deionizing chamber 21 in a direction perpendicular to the path of the arc being drawn between the contact members 2 and 4. This magnetic field reacts in accordance with well-known electromagnetic laws to drive the arc upward in the chamber 21 toward the plates 24 and into the V-shaped groove formed by the contours of their lower ends. The proximity of these relatively cold metal plates tends to diminish the cross-sectional area of the arc, probably by rapid extraction of energy in the form of heat and the discharging of ions present in the peripheral layers of the arc. At any rate, it is a fact that the arc concentrates in a smaller volume and its voltage gradient rises. This causes the current to fall to zero more rapidly than it otherwise would. For currents at nearly 100% power factor, the current will reach zero when the generated voltage is less than the voltage required to maintain the arc in the groove. Then the current will stay zero until the generated voltage following its normal sine wave rises to a value again sufficient to maintain an arc in the groove. This, however, takes so long a time that during its course the conductivity of the air in the groove is completely lost, and the arc does not reignite. If, however, the power factor of the current is nearly zero when the current reaches zero, the voltage across the switch rises almost immediately

to the peak value of the generated voltage, which tends to reignite the arc in the opposite sense. The time for this voltage rise depends on the inductance and capacity of the leads and apparatus to which the switch is connected and is usually of the order of $\frac{1}{100,000}$ second. Because this time is so short, it is necessary that the ions be removed from the arc with great rapidity if reignition is to be prevented. The very close proximity of all parts of the arc in the slot to the metal plates causes a very rapid deionization, because all the ions which reach the plates are thereby discharged. The narrower the slot in which the arc finds itself at the time of current zero, the more rapid will be the deionization, and the higher the voltage which may be interrupted at zero power factor without arc reignition.

Under normal operating conditions, the strength of the magnetic field of magnet 27 is of such magnitude in relation to the current and assemblage of plates as to force the arc stream up to the apex of the groove but not onto the plates 24, and consequently its extinction occurs within the confines of the groove.

If, however, the magnetic field is made too strong, the arc will be driven into the spaces between the metal plates 24, and caused to form a series of short arcs, each short arc having terminals on pairs of plates 24. Under these conditions, if the plates 24 are not to be burned by the arc terminals, the arcs must be moved very rapidly along the plates 24, and a magnetic field sufficiently strong to accomplish this should be provided, and also the plates 24 should be sufficiently long so that, in spite of the high velocity, the arcs do not reach the end of the structure before the current zero.

In general, however, it may be preferable to work with the magnetic field and structure so proportioned that the arc does not pass beyond the slot up to the time it is extinguished.

It will be evident that although in structure described the current in the arc-horns and arc constitutes the principal magneto-motive force exciting the blowout magnet, this arrangement is adjunctive rather than essential to my invention and that excitation of the blowout magnet by a winding in series with the arc or otherwise would still be within the scope of my invention.

It will be evident that, if the groove, which has been characterized as V-shaped in my deionizing structure is to have the effects described, it is advantageous, if not positively essential, that it shall run to rather a narrow groove in order that the arc shall be in intimate contact around a large part of its periphery with the deionizing plates.

In reference to the design of my deionizing structure, it may be said that reformation of the arc between the plates after the current passes through zero will be most effectively prevented if the part of the groove in which the arc is located at current zero is very narrow. At the same time to bring the arc into this narrow slot from the point where it is drawn, it is necessary that the sides of the V shall taper in gradually in the manner shown in Figs. 3 and 5.

A study of heat flow in such plates as members 24 has shown that only a relatively thin layer on the surface plays much part in carrying away heat where arcs are extinguished in half a cycle of 60 cycle current. Hence, the use of heavy deionizing plates is uneconomical. The deionizing effect is greater the greater the num-

ber of plates; wide spacing is, of course, poor economy; and much closer spacing than $\frac{1}{4}$ of an inch would be liable to cause trouble from dust accumulations or accidental introduction of other foreign matter between the plates. Thus the factors determining the design of my deionizing structure are evident.

By means of my invention, therefore, the arc incident to opening of the contactor is driven into a deionizing structure where it is quenched before it has time to perceptibly burn or pit the plates thereof, this movement along the arc horns from its place of initial formation taking place so rapidly that no appreciable burning of the contact-members occurs. In consequence, where the prior art has found oil switches necessary, air-break circuit breakers may be designed according to the principles of my invention for many conditions of service, with a resulting decrease of cost and a greater ease of installation and the elimination of fire hazard. Even on services where air-breaks have previously been used the circuit breakers may be made with lighter parts and are of increased durability.

It will be understood that many features which I have described are adjunctive to each other. Thus, it is not essential that the plates forming the sides of the V-shaped groove be integral with those constituting the upper portion of the deionizing structure and even a structure embodying the V-shaped groove, but providing no path of operation for a subdivided arc, would be within the purview of my invention.

The principles which have been embodied in my circuit breaker are applicable to many other purposes than those of circuit interruption. I, therefore, desire that the language of the appended claims shall be accorded the broadest reasonable construction and that my invention be limited solely by what is explicitly stated in the claims and by the prior art.

I claim as my invention:

1. In combination, means to establish an arc and a structure comprising a plurality of conducting plates having open spaces therebetween and aligned notches of V-shape, said notches halving in width in every longitudinal distance of from one-tenth inch to two inches and positioned in a portion of the arc path.

2. In combination, means to establish an arc, means for moving said arc into a deionizing structure, means for extracting energy from said arc as it is being moved into said structure, said energy-extracting means comprising a groove, formed by aligned notches in a plurality of conducting plates having open spaces therebetween, said notches being so shaped that $\frac{dw}{dl}$ increases as l increases, l being distance measured along the axis of the notch from its apex and w being width of the notch measured perpendicular to the axis.

3. In combination, means to establish an arc, means for moving said arc into a deionizing structure, means in intimate contact with said arc for extracting energy therefrom as it is being moved into said structure, said energy-extracting means comprising a groove having portions of less width than said arc, said groove being formed by aligned converging notches in a plurality of thin conducting plates having open spaces therebetween, said notches having edges which are curves convex toward each other.

4. In an arc extinguishing device, a plurality of metal plates having open spaces therebetween, each of said plates having a notch therein which tapers inwardly and has edges which have a slope with respect to the longitudinal axis of the notch which is large at the entrance to the notch and which approaches zero near the inner end of the notch.

5. In an arc extinguishing device, a plurality of metal plates having open spaces therebetween, each of said plates having a notch therein which extends into the plate for the major portion of the length of the plate, said notches being aligned and having edges which taper inwardly and have a slope with respect to the longitudinal axis of the notch, which is large at the entrance to the notch and which approaches zero near the inner end of the notch.

6. In an arc extinguishing device, a plurality of metal plates having open spaces therebetween, each of said plates having a notch therein which extends into the plate for the major portion of the length of the plate, said notches being aligned and having edges which taper inwardly and have a slope with respect to the longitudinal axis of the notch, which is large at the entrance to the notch and which approaches zero near the inner end of the notch and said notch having a considerable portion of its length at its inner end of such width as to restrict the cross-section of the arc.

7. In an arc extinguishing device, a plurality of metal plates having open spaces therebetween, each of said plates having a notch therein which tapers inwardly and has edges which have a slope with respect to the longitudinal axis of the notch, which is large at the entrance to the notch and which approaches zero near the inner end of the notch, the width of said notch adjacent its inner end being such as to restrict the

cross-section of the arc and increase its current density and potential.

8. In an arc extinguishing device, a plurality of non-magnetic conducting plates, each of said plates having a notch therein which tapers inwardly and has edges which have a slope with respect to the longitudinal axis of the notch, which is large at the entrance to the notch and which approaches zero near the inner end of the notch.

9. In an arc-extinguishing device, a plurality of metal plates having open spaces therebetween, each of said plates having a notch therein which tapers inwardly, which is large at its entrance and which approaches zero width near its inner end.

10. In combination, means to establish an arc, means for moving said arc into a deionizing structure, means for extracting energy from said arc as it is being moved into said structure, said energy-extracting means comprising a groove formed by aligned notches in a plurality of conducting plates having open spaces therebetween, said notches being so shaped that $\frac{dw}{dl}$ increases as l increases, l being distance measured along the axis of the notch from its apex and w being width of the notch measured perpendicular to the axis, and said open spaces between the plates extending to two different sides of the deionizing structure so as to provide through ventilating passages between the plates.

11. In an arc-extinguishing device, a plurality of metal plates having open spaces therebetween, each of said plates having a notch therein which tapers inwardly, which is large at its entrance and which approaches zero width near its inner end, and said open spaces between the plates providing a through ventilating passage between the plates.

JOSEPH SLEPIAN.

45 120

50 125

55 130

60 135

65 140

70 145

75 150

March 8, 1938.

A. V. DE FOREST

2,110,759

TESTING APPARATUS

Filed July 19, 1935

Fig. 1

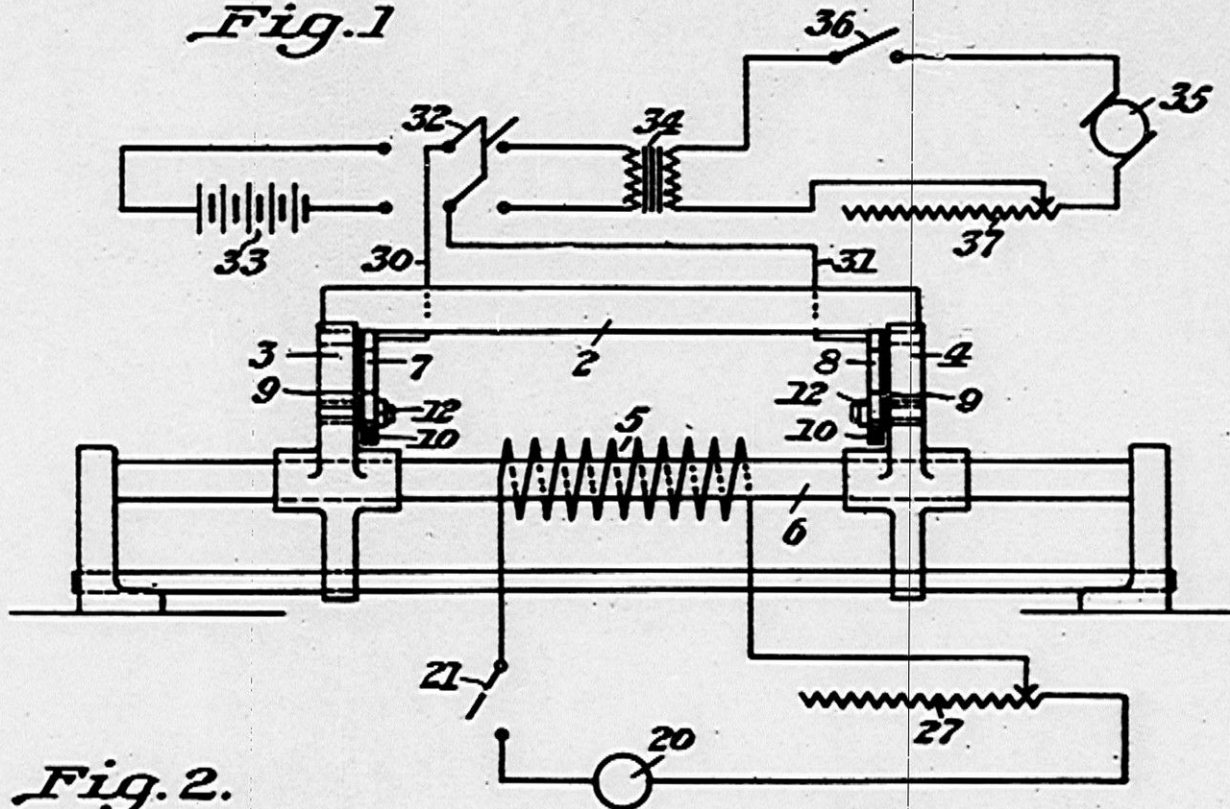


Fig. 2.

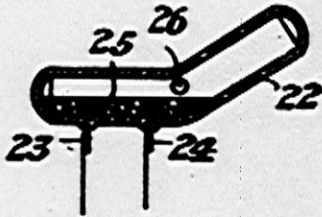


Fig. 3.

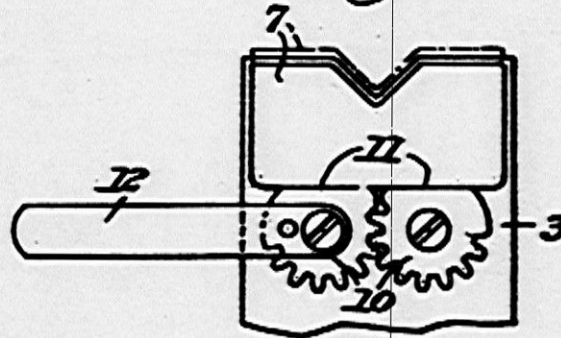
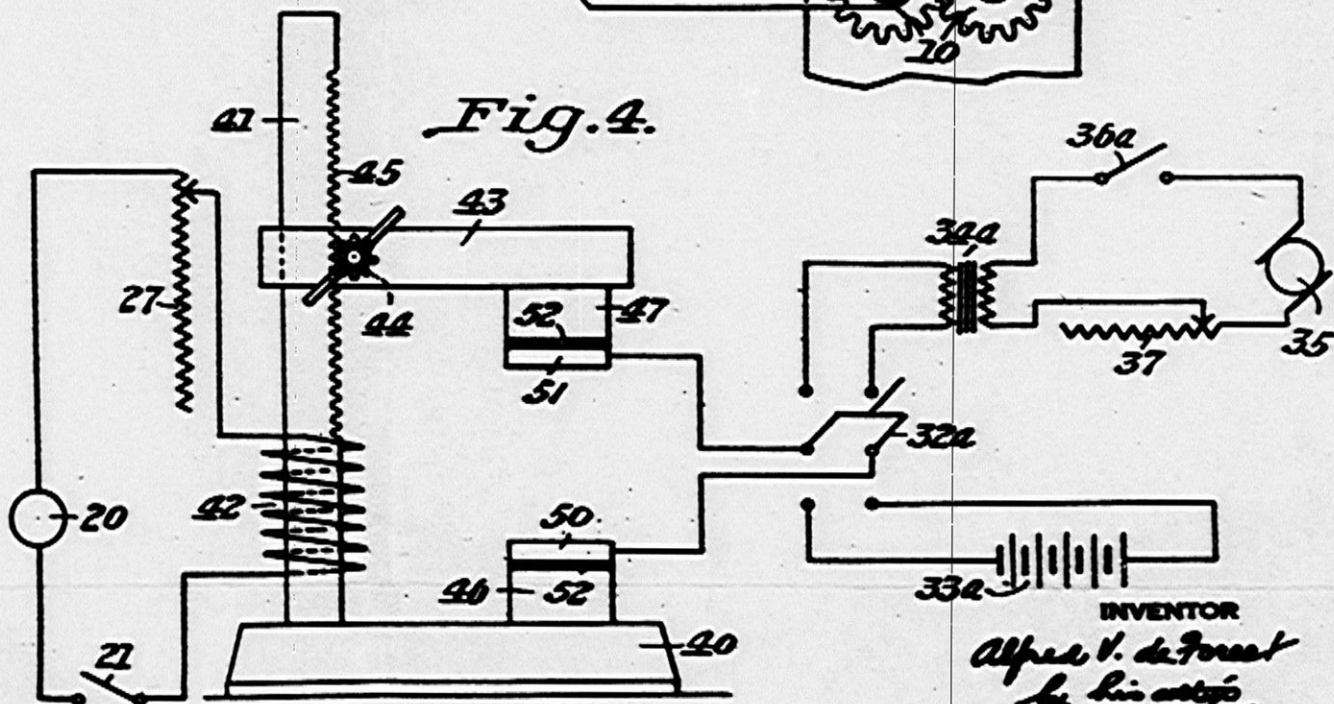


Fig. 4.



INVENTOR

Alfred V. de Forest
by his atty
Rogers, Sullivan & Plummer

UNITED STATES PATENT OFFICE

2,110,759

TESTING APPARATUS

Alfred V. de Forest, Southport, Conn., assignor
to Magnaflex Corporation, Pittsburgh, Pa., a
corporation of Pennsylvania

Application July 19, 1935, Serial No. 32,165

9 Claims. (Cl. 175-183)

The present invention relates to testing apparatus, and more especially to apparatus for the magnetic testing of objects of paramagnetic material.

5 In my prior patent, No. 1,960,898, I have explained the testing of objects of paramagnetic material, such, for example, as iron and steel articles, to detect cracks, flaws, etc. in the metal. Briefly stated, the method comprises magnetizing
10 the article and applying to the surface of the article finely divided magnetic material. There is a tendency for the finely divided particles to cluster on the surface at places where there is a crack or flaw. In this way cracks or flaws may
15 be detected, although not visible to the eye.

The present invention relates to improved apparatus for carrying out testing of this character. In this apparatus the test piece may be subjected to magnetization by means of an electro-
20 magnet, and also magnetization by means of an electric current passed through the test piece. As hereinafter explained, the piece can thus be subjected to magnetic lines of force in different directions so as to better detect both longitudinal
25 and transverse cracks. The apparatus is also provided with means for demagnetizing the article.

In the drawing—

30 Figure 1 is a diagrammatic view showing one form of apparatus embodying the invention;

Figure 2 is a detail view showing the preferred form of switch for breaking the alternating current when used for magnetizing;

35 Figure 3 is a detail view of the current contact elevating mechanism; and

Figure 4 is a diagrammatic view of a modified form of apparatus.

Referring to the embodiment illustrated in Figure 1, the test piece 2 is supported on pole
40 pieces 3 and 4 of the electromagnet 5. For simplicity the test piece is shown as a shaft, although other objects may be tested, preferably objects of greater length than width with the type of apparatus illustrated in Figure 1. The pole
45 pieces 3 and 4 are adjustable along the core bar 6 of the electromagnet 5 in order to accommodate objects of different length. The core and pole pieces of the electromagnet are preferably made of laminated soft steel sheets to cut down eddy
50 currents when alternating current is employed. Carried by the pole pieces 3 and 4 are electric contact pieces 7 and 8 insulated from the pole pieces by means of insulation 9. These electric
55 contact pieces may be raised or lowered by means of the elevating mechanism shown in Figure 3

which consists of two toothed wheels 10 insulated from the pole pieces having cam surfaces 11 and operated by means of a handle 12. When the object is to be tested by means of the electro-
magnet 5, the electric contacts 7 and 8 are
5 lowered to allow the objects to come in direct contact with the pole pieces 3 and 4. When the object is to be tested by passing the electric current through it, the electric contact pieces 7 and
8 are raised to lift the test piece off of the pole
10 pieces 3 and 4.

The test piece may be tested by means of applied magnetism from the electromagnet 5. When this is done the lines of electromagnetic flux tend to run longitudinally of the test bar 2,
15 creating a testing condition most favorable for detecting laterally extending cracks which are at right angles to the major axis of the test piece 2.

The test piece can also be subjected to magnetization so that the magnetic lines of flux lie
20 circumferentially of the test piece 2 and at right angles to the length of the test piece. This may be done by passing the electric current through the test piece. This causes a magnetic condition most favorable for the detection of cracks
25 which run longitudinally of the test piece and parallel of its major axis. Also, the current testing does not produce polar effects at the end of the test piece and inspection may be carried close
30 to the ends.

The current for the electromagnet 5 is supplied from a suitable source, such as a generator 20, which may be either a direct current generator or alternating current generator. When an ob-
35 ject of soft iron or steel is to be tested, the current is allowed to remain on during testing. When a hard steel object is to be tested, the current can be applied and the object permanently magnetized. When alternating current is used
40 for magnetizing a hardened steel article, the switch 21 should be such as to break the current at the end of a half current cycle. When this is done the object is left permanently magnetized. The magnetism imparted by the previous half
45 cycle is left in the article. For this purpose the preferred form of switch is a mercury switch, as shown in Figure 2, which consists of a tube 22 having two contacts 23 and 24 extending through
it and into a pool of mercury 25. When the tube
50 is tilted to the right about its axis 26 the mercury flows to the other end of the tube and the circuit is broken. It is one of the characteristics of such a mercury switch that the current is broken at
55 the end of a half cycle when the current reaches zero value. While I prefer to use the mercury

break switch in order to insure the breaking of the current at substantially the end of a half current cycle, other forms of switches may be used. For example, a switch having contacts made of some relatively fusible metal, such as brass or copper, and which has a not too fast separation of the contacts, will break the current at substantially the end of a half current cycle. The readily fusible metal forms a metallic arc and if the contacts are separated relatively slowly, such arc persists until the end of the half current cycle.

In case it is desired to demagnetize the article after the testing, as, for example, a hardened steel article, the article can be demagnetized by means of the electromagnet 5 by passing an alternating electric current through it and gradually reducing the value of the current to substantially zero by means of a variable resistance 27.

The electric contacts 7 and 8 may be supplied with either direct or alternating current. For this purpose the leads 30 and 31 to the contact pieces 7 and 8 are connected with a double pole double throw switch 32. When the switch 32 is thrown to the left as shown in Figure 1, the current from the battery 33 is passed through the test piece 2. The passage of the current through the test piece induces magnetism therein, the magnetic lines of force running circumferentially around the test piece.

When the switch 32 is thrown to the right, the test piece is connected to alternating current. For this purpose there is provided a step-down transformer 34 whose primary is connected with an alternating current generator 35. A switch 36 is provided preferably of the same character as the switch 21, whereby alternating current may be used, if desired, for permanently magnetizing a hardened steel article.

The article may be demagnetized by passing the alternating current through it and gradually reducing the current to substantially zero by means of a variable resistance 37.

As will appear from the above description, the test piece may be subjected in one testing apparatus to both longitudinally and transversely directed lines of magnetic flux. Not only the direction, but also the distribution of the magnetic flux can be controlled by the apparatus. A magnetic flux which is distributed substantially uniformly through the body of the test piece can be secured by magnetizing it by means of the electromagnet 5, particularly when direct current is used for this purpose. On the other hand, a concentration of the magnetic flux at the surface of the article can be secured by magnetizing it by passing an alternating current through the article. In this case the magnetic flux is concentrated at the surface due to the "skin effect" produced by the current alternations. This distribution of flux is particularly desirable for detecting surface flaws.

After the test piece has been tested by applying the finely divided magnetic material as described in my Patent 1,900,208, it can be demagnetized in the same apparatus as above explained.

In Figure 4 is illustrated a modification intended for the testing of shorter more chunky pieces of material. This form of apparatus comprises a base 40 having an upright 41 carrying an electromagnet coil 42. An arm 43 is adjustable on the upright 41 by means of a gear 44 meshing with rack teeth 45 in the upright. The base 40 has a magnetic pole piece 46 and the arm 43 carries a complementary pole piece 47. Conducting plates

50 and 51 are provided for the pole pieces 46 and 47 respectively, and are insulated therefrom by insulation 52.

The piece to be tested is clamped between the pole pieces 46 and 47 which carry the contacts 50 and 51 when testing is to be carried out by passing the electric current through the test piece. When the testing is to be carried out by the applied magnetism from the electromagnet 42, the contact pieces 50 and 51 are removed so as to bring the iron pole pieces into direct contact with the article.

The object to be tested may be clamped in different positions between the pole pieces 46 and 47, to thereby produce magnetic fluxes in different directions in the object to be tested. In this way effective testing for cracks running in different directions may be had. The differences in direction of the magnetic fluxes may also be secured by testing with the electromagnet which produces flux in a vertical direction, and by passing the electric current through the object which produces a circumferential flux in the horizontal direction.

The current connections for the electromagnet 42 and the contacts 50 and 51 are similar to those shown in Figure 1 and corresponding reference characters are used therefor.

While I have illustrated and described the preferred embodiment of my invention, it is to be understood that the invention may be otherwise embodied and practiced within the scope of the following claims.

I claim:

1. Apparatus for the magnetic testing of objects of paramagnetic material, comprising an electromagnet having adjustable pole pieces for engaging the object, and contact pieces carried by the pole pieces for also engaging the object to pass an electric current directly through the object.

2. Apparatus for the magnetic testing of objects of paramagnetic material, comprising an electromagnet having adjustable pole pieces for engaging the object to be tested, electrical contacts carried by the pole pieces, and means for moving the contacts against the object to be tested and raising it away from the pole pieces, and means for supplying electric current to the contact pieces.

3. Apparatus for the magnetic testing of objects of paramagnetic material, comprising an electromagnet having adjustable pole pieces for engaging the object to be tested, contact plates arranged to be interposed between the pole pieces and the piece to be tested, and means for supplying current to the contact plates.

4. Apparatus for the magnetic testing of objects of paramagnetic material, comprising an electromagnet having pole pieces for engaging the object, means for supplying electric current to the electromagnet, electric contacts on said pole pieces for engaging the object, and means for supplying electric current to said contacts.

5. Apparatus for the magnetic testing of objects of paramagnetic material, comprising means including contact pieces for producing magnetic flux in one direction in the object and means on said contact pieces for producing a magnetic flux in the object at an angle to the first flux.

6. Apparatus for the magnetic testing of objects of paramagnetic material, comprising an electromagnet having pole pieces engaging the object, electric contact pieces mounted on said pole pieces adapted to be brought into contact

with the object to be tested for passing electric current directly through said object to magnetize said object, and means for passing an alternating current of decreasing intensity through said object to demagnetize the same.

5 7. Apparatus for the magnetic testing of objects of paramagnetic material, comprising an electromagnet for magnetizing the object, means for supplying a magnetizing current to the elec-
10 tromagnet, electric contacts mounted on the pole of said electromagnet for engaging the object, means for supplying an alternating current to said contacts, and means for gradually reducing the alternating current to demagnetize the ob-
15 ject.

8. Apparatus for the magnetic testing of objects of paramagnetic material, comprising an electromagnet for magnetizing the object, means

for passing either a direct or an alternating current through the electromagnet, electrical contacts movably mounted on the poles of said electromagnet for engaging the object, and means for passing either a direct or an alternating current to the object through such contacts, and
5 means including a variable resistance for gradually cutting down an alternating current to demagnetize the object.

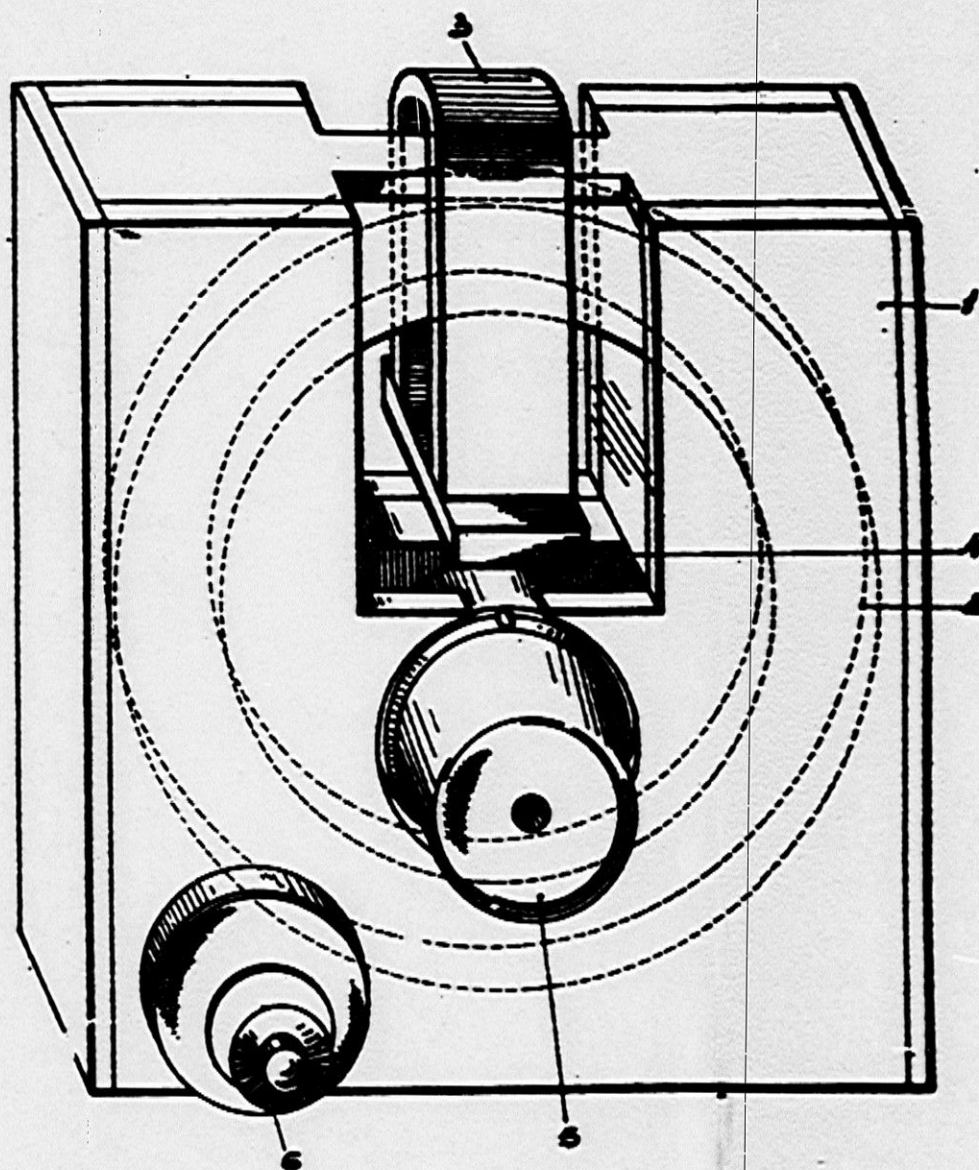
9. Apparatus for the magnetic testing of ob- 10
jects of paramagnetic material, comprising an electromagnet for producing a flux through the object in one direction, and means on the poles of said electromagnet for passing current directly through the object to produce a magnetic
15 flux in another direction in the object.

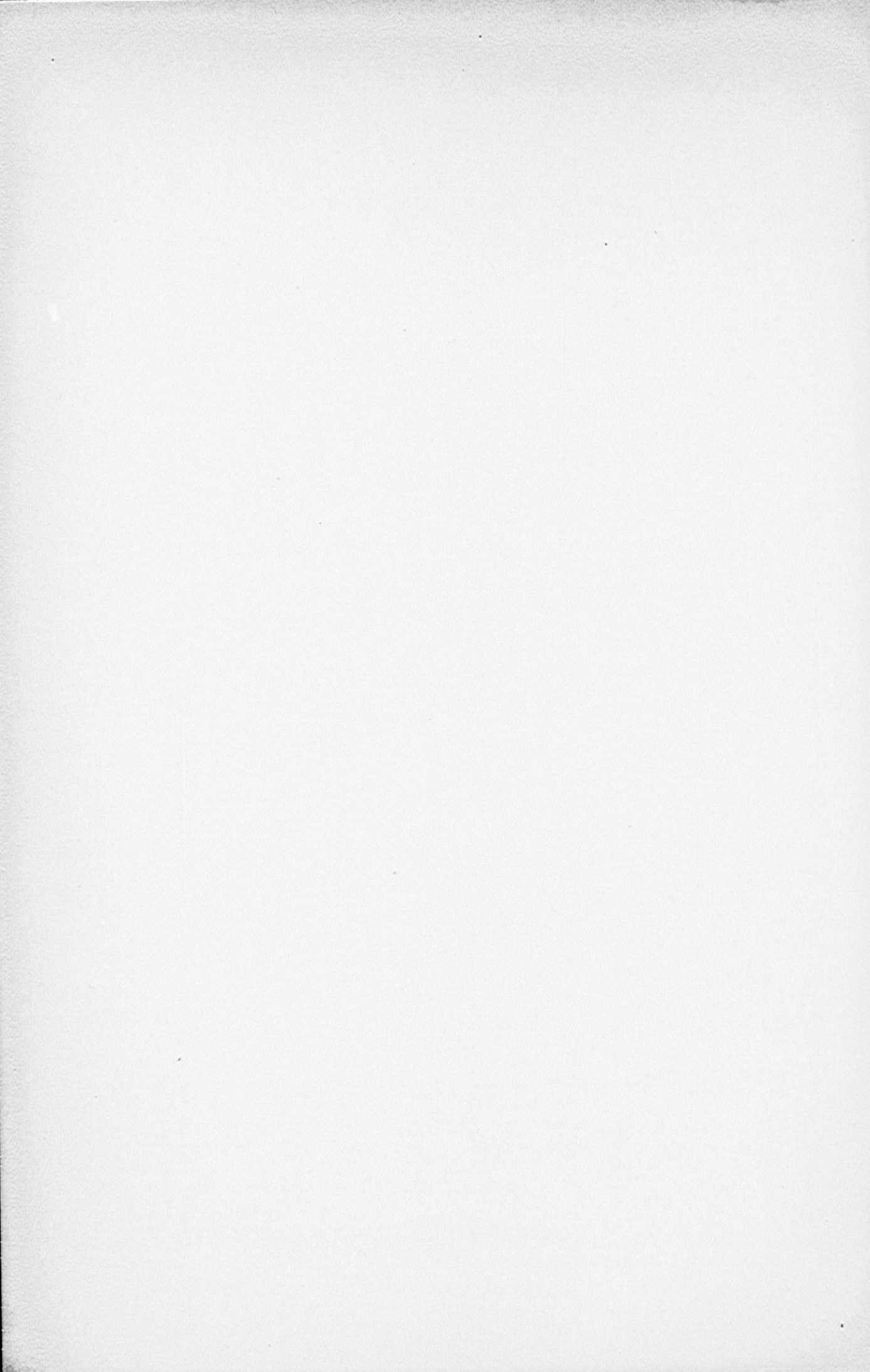
ALFRED V. DE FOREST.

N° 593.863

M. van Meyl

Pl. unique





374 Translation of French patent no. 593 863, class XII-5, to Josephus Idocus van Meyl residing in the Netherlands, applied for Nov. 25, 1924, granted June 6, 1925, published Sept. 1, 1925.

Method and apparatus for magnetizing purposes.

For the purpose of magnetizing permanent magnets various means are used with which we magnetize with the aid of a direct current. For example the magnetizing apparatus may be connected to a storage battery or, if we are using an alternating current source a current rectifier is inserted in the magnetizing circuit.

The invention has for object simplifying the magnetization and more particularly rendering possible the use of an alternating current without the necessity of having a current rectifier.

According to the invention the current in the magnetizing coil is dimensioned so that the magnetization will take place in the space of time which elapses between the putting in circuit of the coil and the interruption of the circuit of the coil by an automatic circuit breaker interposed in this circuit. For this purpose the apparatus which is the object of the invention comprises a device serving to connect the coil to a source of current and an automatic circuit breaker interposed in the circuit of the coil. The automatic circuit

375 breaker must be dimensioned so that on the one hand it will interrupt the current produced in the circuit of the coil when the latter is connected to the line voltage which the apparatus is designed to carry and on the other hand the current can attain the necessary value for the magnetizing of the magnet.

The magnetizing coil is placed preferably in a tank having one or more pockets for the introduction of one or more magnets and having a circuit breaker for the cutting-in of the coil and a junction box which is intended to connect the apparatus to some source of current and which incloses a fuse.

Very good results are obtained by using a magnetizing coil of annular form.

The attached drawing, given by way of example, shows an apparatus in which the invention is realized.

In a tank 1, of wood for example, is located a magnetizing coil 2 insulated in suitable manner. The lid of the tank supports a junction box 5 intended to connect the apparatus to a source of current. In the box 5, the lid of which may be easily removed, is a fuse interposed in the circuit of the coil 2. The lid of the tank carries furthermore a push-button circuit breaker 6 for putting in circuit the coil 2. In this tank 1 is provided a recess in which can be introduced a horseshoe magnet 3 in such a way that its shanks will surround the coil 2. The magnetic circuit of the magnet is completed by an obturating member of suitable form 4. This

376 member 4 has preferably such shape that the air gap will pass almost through the center of the coil 2.

The number of the turns and the cross section of the wires of the coil 2 as well as the fuse inclosed in the box 5 are chosen so that by pressing the push-button 6 the magnet 3 will be sufficiently magnetized almost immediately, that is, in the space of time which elapses between the putting in circuit of the coil and the interruption of the current by the fuse which is located in the box 5.

In certain cases it will be necessary, in view of the voltage of the current source to provide the coil with parallel windings so as to insure a sufficiently strong current for immediate magnetization.

In the case where magnets of the same composition and the same dimensions must be magnetized to the same degree the apparatus may be adapted to the introduction of several magnets at once. Such an apparatus offers also the advantage that the consumption of fuses is diminished.

Instead of fuses we might also use other automatic circuit breakers but it has been found in practice that the use of fuses gives excellent results.

The apparatus may be connected to a source of direct or alternating current. Many experiments made with the aid of an alternating current have shown that a sufficient magnetization may be obtained in this case too. It seems that the automatic circuit breaker interrupts the current always at the time when the intensity of the field is near its maximum. It is true that by using an alternating current we shall not be sure of the direction in which the magnetization takes place, however that is not of importance for in the event where the direction of magnetization is indicated in advance we only have to repeat the magnetization of the magnet until the direction of magnetization is correct. In the case where two or more magnets must be magnetized in the same direction it is preferable to magnetize them both at the same time.

The magnetization according to the invention offers remarkable advantages. Thus the apparatus for applying the method which is the object of the invention may be of very simple construction and furthermore the magnetization can be effected in very little time. The consumption of power during each magnetization is a minimum and the use of new fuses is not very costly. By using a circuit breaker of different construction, as for example an electromagnetic circuit breaker, we can avoid the replacement of fuses.

Resumé

The invention concerns:

1. A method of magnetizing permanent magnets, characterized in that the current in the magnetizing coil is dimensioned so that the magnetization will occur in the space of time which elapses between the putting in circuit of the coil and the interruption of the circuit of the coil by an automatic circuit breaker interposed in this circuit; furthermore this method has the special advantage that the magnetizing of several magnets of the same composition and having the same dimensions is effected simultaneously.

378 2. An apparatus for magnetizing purposes comprising a magnetizing coil, means serving for the connection of the coil to a source of current and an automatic circuit breaker interposed in the circuit of the coil, it being possible for this apparatus to be made up of a tank in which the coil is placed showing one or more recesses (pockets) for the introduction of one or more magnets and carrying a circuit breaker for putting in circuit the coil and a junction box which serves to connect the apparatus to a supply of current and which contains a fuse, the magnetizing coil having, preferably, an annular shape.



Convention Date (Austria): May 24, 1930.

379,337

Application Date (in United Kingdom): May 26, 1931. No. 15,434 / 31.

Complete Accepted: Aug. 26, 1932.

COMPLETE SPECIFICATION.

Improvements in and relating to Magnetizing Apparatus.

I, ALEXANDER HAUSER, of Kaarstrasse 29, Linz a.d. Donau, Austria, of Austrian Nationality (Assignee of HAUSER & Co., of Landstrasse 21, Linz 5 a.d. Donau, Austria, a Company organised under the laws of Austria), do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a magnetizing apparatus for operation with alternating current. In magnetizing devices the coils of which for the generation of the magnetizing field are supplied with alternating current it has hitherto proved a matter of difficulty in the first place to utilize the greatest strength of the alternating field for the magnetizing process, and secondly to determine in advance the polarity of the object to be magnetized. With a hand operated switch it is obviously impossible to effect with any certainty the interruption at the right moment of the alternating current traversing the magnetizing coils. But even interruption at the neutral point, as already proposed for the primary circuit of a transformer fed with alternating current, which could also be used as a magnetizing apparatus, merely ensures the interruption at a moment at which the field of the secondary winding possesses its maximum strength, but not the attainment of the desired polarity in the object to be magnetized.

The present invention provides a magnetizing apparatus, the coils of which for the direct generation of the magnetizing field are fed with alternating current, in which the utilization of the strongest field and the attainment of the desired polarity in the magnetized object is achieved by the employment of a polarized relay connected in parallel with the magnetizing coils for the interruption of the alternating current traversing the magnetizing coils.

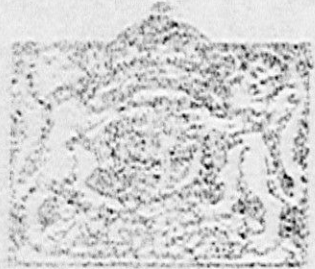
The accompanying drawing illustrates, in a practical example, the construction and connecting of the polarized relay in the circuit of the alternating current

traversing the coils of the magnetizing apparatus, these coils themselves, however, being omitted in the drawing.

Referring to the drawing, the one end of the winding of a relay 3 is connected by means of a conductor 1 through a reactance or choking coil 2, to an alternating current supply, the other end of this winding being connected by a conductor 4 through a hand-operated switch 5 to the alternating current supply lines. Above the core 6 of the relay 3 there is arranged an armature 7 carried by a lever 10 which is rotatable about a fixed axle 9. From the conductor 1 there is taken a connection to a contact arm 11 which is rigidly connected by means of an insulation piece 18 to the lever 10, and is thus rotatable together with the latter about the axle 9. The end of the contact arm 11 co-operates with a fixed contact 12 from which a conductor 13 leads to the coils of the magnetizing apparatus. A branch conductor 14 derived from the conductor 4 completes the current circuit of the magnetizing coils (not shown in the drawing), so that the relay coil and the magnetizing coils are connected in parallel. Above the relay armature 7 there is arranged the one pole 15 of a permanent magnet 16 which, in conjunction with a spring 17, which is regulatable as to tension, retains the armature 7, the lever 10, and the contact 11 in such a position that the contacts 11 and 12 are closed.

If after the connection of the magnetizing coils to the alternating current supply lines the current circuit of the relay coil 3 be closed by actuation of the switch 5, the core 6 of the relay is magnetized, and that with a polarity alternating with every alternation of the current. If the closing of the current circuit containing the relay 3 be effected in that phase at which the end of the magnetic core 6 facing the armature 7 is of the same polarity as the pole 15 of the permanent magnet 16 the armature 7 remains in the position in which it is shown in the drawing, the contacts 11 and 12 remain closed and the alternating current flows on through the magnet-

[Price 1/-]



INVENTION OF A METHOD OF

1. A method of...
2. The method of...
3. The method of...
4. The method of...
5. The method of...
6. The method of...
7. The method of...
8. The method of...
9. The method of...
10. The method of...

11. The method of...
12. The method of...
13. The method of...
14. The method of...
15. The method of...
16. The method of...
17. The method of...
18. The method of...
19. The method of...
20. The method of...
21. The method of...
22. The method of...
23. The method of...
24. The method of...
25. The method of...
26. The method of...
27. The method of...
28. The method of...
29. The method of...
30. The method of...
31. The method of...
32. The method of...
33. The method of...
34. The method of...
35. The method of...

36. The method of...
37. The method of...
38. The method of...
39. The method of...
40. The method of...
41. The method of...
42. The method of...
43. The method of...
44. The method of...
45. The method of...
46. The method of...
47. The method of...
48. The method of...
49. The method of...
50. The method of...
51. The method of...
52. The method of...
53. The method of...
54. The method of...
55. The method of...
56. The method of...
57. The method of...
58. The method of...
59. The method of...
60. The method of...
61. The method of...
62. The method of...
63. The method of...
64. The method of...
65. The method of...
66. The method of...
67. The method of...
68. The method of...
69. The method of...
70. The method of...
71. The method of...
72. The method of...
73. The method of...
74. The method of...
75. The method of...
76. The method of...
77. The method of...
78. The method of...
79. The method of...
80. The method of...
81. The method of...
82. The method of...
83. The method of...
84. The method of...
85. The method of...
86. The method of...
87. The method of...
88. The method of...
89. The method of...
90. The method of...
91. The method of...
92. The method of...
93. The method of...
94. The method of...
95. The method of...
96. The method of...
97. The method of...
98. The method of...
99. The method of...
100. The method of...